E.3085

BRITISH HOVERCRAFT CORPORATION

POLAR
PAM
4646

POLARPAM

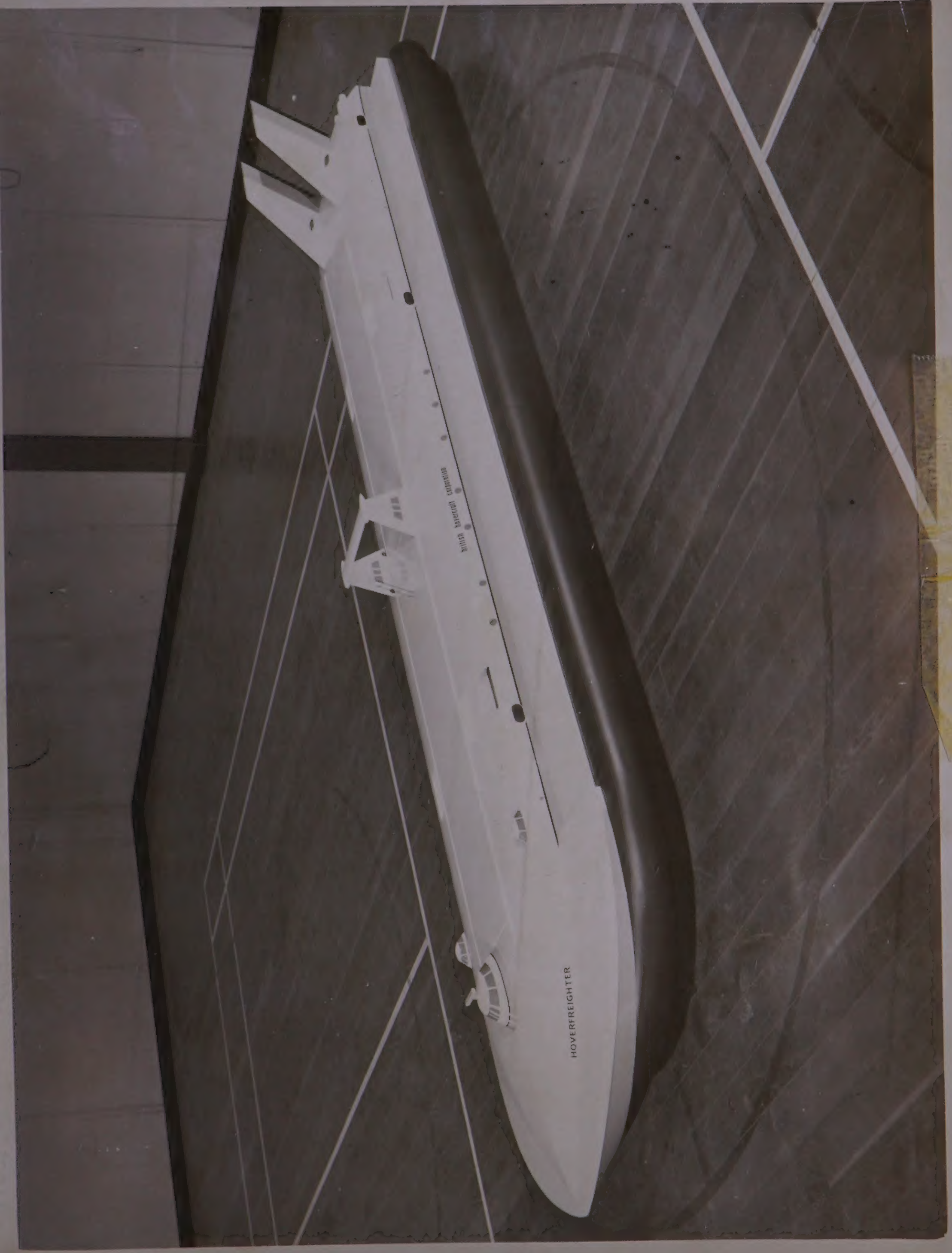
The current five year development programme now being conducted by BHC has as its ultimate target a 300-ton hovership with an open-water capability, a fairly long range and considerable load-carrying capacity. It is, however, possible even at this early stage to extrapolate present technology to project a hoverfreighter of 4,000 tons. This container-carrying craft would have a very large work capacity and would be capable of operating in almost all weather conditions. Being water propelled, it would be confined to overwater operations.

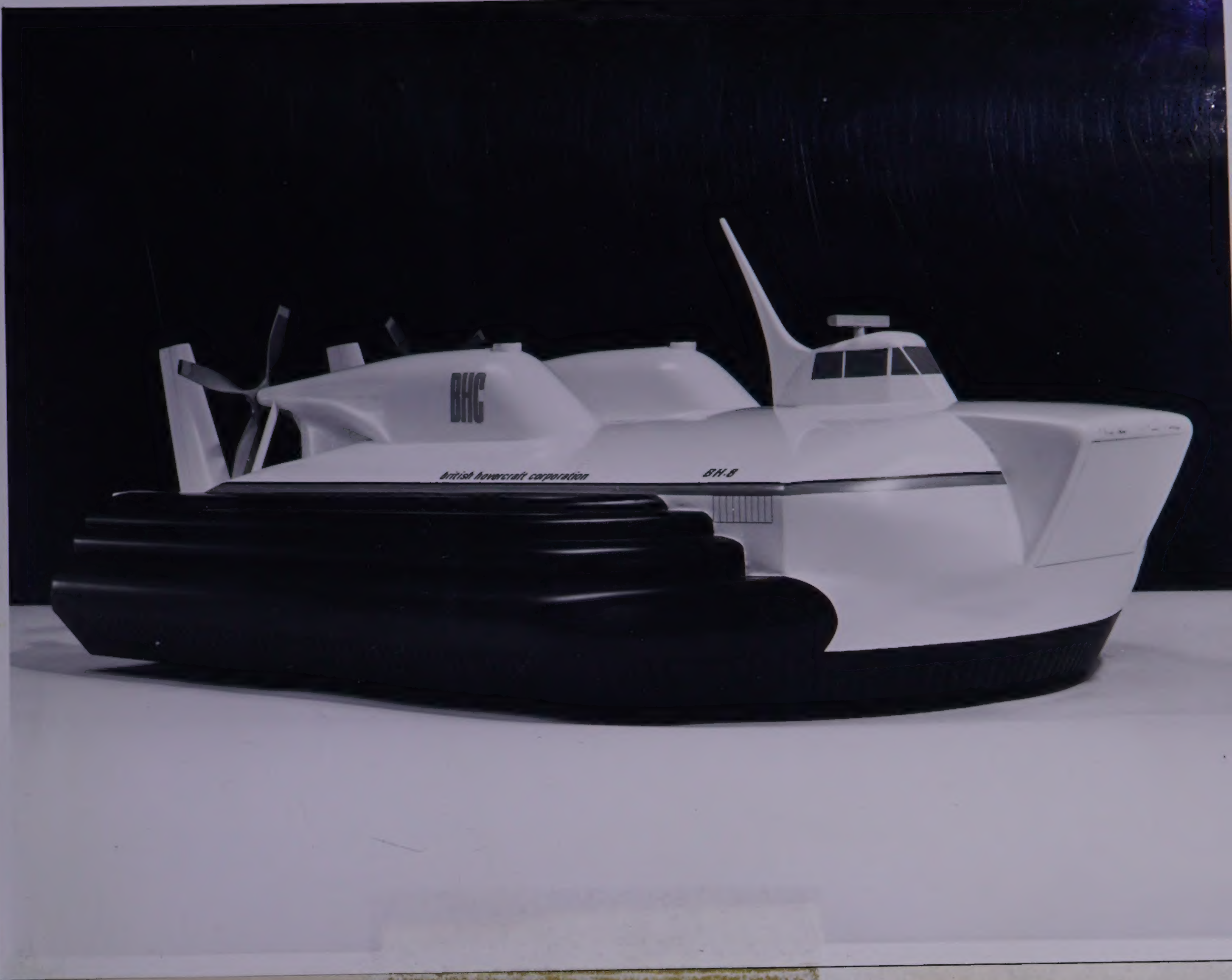
Special loading and unloading gantries and roller-track links would ensure rapid turn-around and allow freight to be transferred directly to road and rail transport.

With the compliments of
BHC Public Relations Department,
Westland Works,
Yeovil. Somerset

October 1967

Tel : Yeovil 5222 Extn. 371


british hovercraft corporation
HOVERFREIGHTER



M.34744

BRITISH HOVERCRAFT CORPORATION

The 80-ton BH.8 is an open-water craft with bow and stern loading facilities.

Powered by twin 3,400 s.h.p. Rolls Royce 'Marine Proteus' gas turbine engines, it has a maximum continuous calm water speed of 75 knots and is capable of 45/55 knots in 4/5 ft. waves.

At a typical commercial gross weight of 90 tons, its spacious interior can accommodate either 280 passengers or 110 passengers and 14 cars or 35 tons of freight.

As a military craft, it is ideally suited for logistic support operations, being capable of carrying laden Army lorries.

The BH.8 is also the largest hovercraft that can be readily transported in one piece as deck cargo, thus facilitating world-wide delivery.

POLAR
PAM
4646

POLARPAM

With the compliments of
BHC Public Relations Department
Westland Works,
Yeovil. Somerset.

October 1967

Tel : Yeovil 5222 Extn. 371

British hovercraft — *the way ahead*

1 9 6 6

THE QUEEN'S AWARD
TO INDUSTRY 1966

WESTLAND AIRCRAFT LIMITED
SAUNDERS-ROE DIVISION

British hovercraft

the

way

ahead

BHC

YEOVIL ENGLAND **british hovercraft corporation limited**

STRENGTH THROUGH UNITY

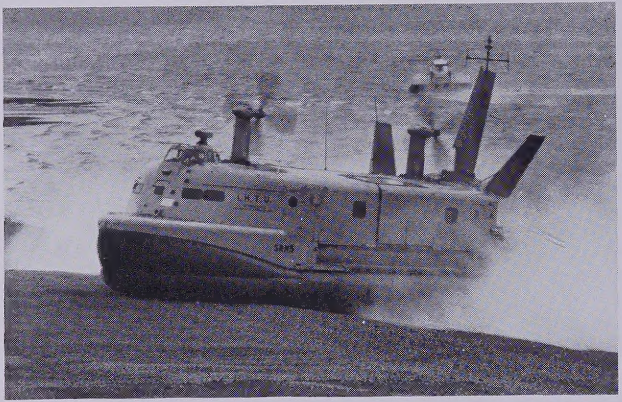
The formation of the British Hovercraft Corporation has concentrated the British hovercraft industry's major technical and other resources under a single Management.

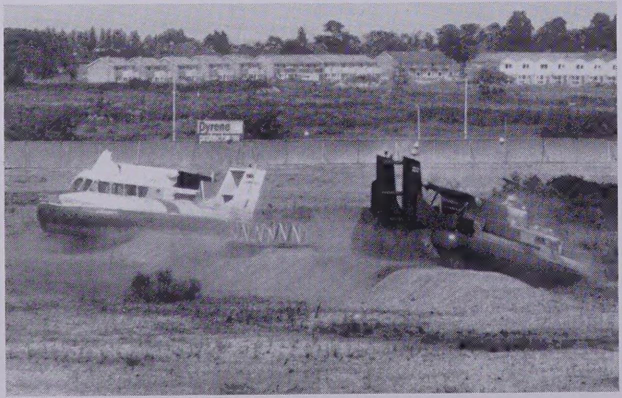
This move eliminated the duplication of research and development which had been inevitable in the past and enabled the Corporation to widen the scope of its programme to include non-marine applications of the air cushion principle, such as hoverpallets and overland load transporters.

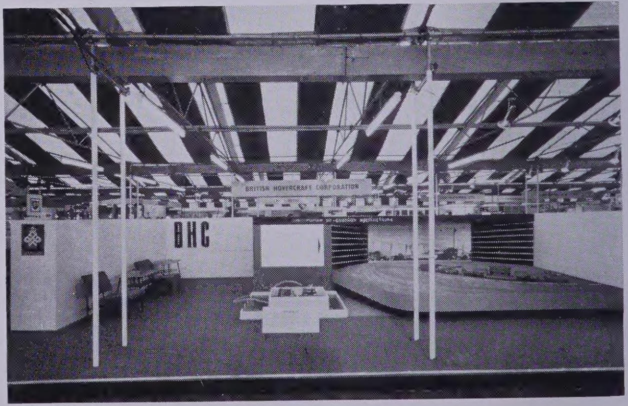
At present, Britain has an undoubted world lead in the field of hovercraft development and contracts for over 30 hovercraft have been secured, 19 of these for overseas customers. But overseas competition is growing fast, particularly from the United States, which is planning a big programme of hovercraft development for the next four to five years. France, Japan and the Soviet Union are also active in this field. With her present economic problems, Britain cannot afford the slightest waste through duplication of effort, if this threat is to be successfully countered.

The capital of B.H.C. is £5m., 65% of it held by Westland Aircraft Limited, 25% by Vickers Limited, and 10% by the National Research Development Corporation.

HOVERSHOW '66







'An unqualified success' were the words used by Mr. E. C. Wheeldon, C.B.E., Chairman of the British Hovercraft Corporation and British Hovercraft Association, to describe 'Hovershow '66' which was held in June of 1966 on Browndown Ranges, near Gosport in Hampshire. 'Interest among the thousands of V.I.P. guests far exceeded even our most optimistic forecasts. Having so many important prospects from all over the world together in one place enabled us to cover a tremendous amount of ground in a few days. I am certain that a lot of valuable business will result from the Show.'

Sponsored by the British Hovercraft Association in collaboration with B.P. Limited, 'Hovershow' showed the world what the British industry has to offer now in terms of production craft already proven in commercial and military service, and what it is capable of producing in the decades ahead. In no other country could such a comprehensive and sophisticated range of hovercraft have been assembled for such an occasion. This fact alone was tangible evidence of the commanding lead which the British industry holds in this field of development – a lead which it firmly intends maintaining.

On the Opening Day, the Show got off to an encouraging start with the announcement of an order by the Ministry of Defence for two new B.H.C. hovercraft, designated BH.7.

The highlight of the Show was the mobile demonstration. Dominated by B.H.C.-built craft, the programme included firefighting, rescue, beach assault and off-shore interception exercises, culminating in an impressive 'fly-past' in formation by the 37-ton SR.N3, two SR.N5's and two SR.N6's.

In the Exhibition Pavilion, over 40 companies displayed their products, reflecting the great financial and technical resources which are now being devoted to hovercraft research and development throughout the U.K.

Prominent in the Exhibition was the B.H.C. display stand. Illustrating immediate future proposals were models of BH.7 and BH.8 unveiled for the first time in public, but the dominant feature was a model of a 4,000-ton ocean-going hoverfreighter indicating what could be achieved using present-day technology.

Industrial applications of the air-cushion principle were represented by a model of the Heavy Load Transporter now in service with the C.E.G.B. and a working model of a hoverpallet capable of lifting over 400 lbs. on a cushion air pressure of only 1·5 p.s.i. provided by an ordinary domestic vacuum cleaner.

Above all, 'Hovershow' proved that British hovercraft are the products of a soundly based industry, fully-equipped to meet the growing world-wide demand for these unique craft.

Corner of the B.H.C. stand showing the BH.7, BH.8 and hoverfreighter.

Equally at home over land and water, the powerful 37-ton SR.N3 fully laden with military equipment sweeps up the steep gradient of the beach at Browndown to its inland destination.

A military SR.N5 races for the shore after plucking 25 survivors from the sea in a rescue demonstration. The normal passenger capacity of the SR.N5 is 18.

Two SR.N5's demonstrate their impressive obstacle-clearance capability during the mobile demonstration.

View of the B.H.C. stand showing the working model of the hoverpallet and a static model of the Heavy Load Transporter for the C.E.G.B.

CIVIL HOVERCRAFT

B.H.C. has the world's only hovercraft production line, located at Cowes, Isle of Wight. A 'run' of 40 SR.N5's and SR.N6's is in hand on a joint line, and the first four SR.N4 passenger/vehicle ferries are also under construction. Preliminary steps for the further extension of the SR.N5/SR.N6 'run' have already been taken.

An SR.N6 used by British Rail on their Southampton/Cowes 'Seaspeed' Service cruising across the Solent.

Artist's impression of a low cost cross-Channel hoverport designed around the 165-ton SR.N4.

Passengers disembarking from one of the two SR.N6's operated by Hovertravel Limited, at Ryde, Isle of Wight.

An SR.N5 crossing San Francisco Bay on a scheduled passenger ferry run.

Contracts won to date cover over 30 craft in all, most of which are SR.N5's or SR.N6's. Nineteen of the craft are for overseas customers, and include two SR.N4's for Hoverlloyd who are to open a passenger/vehicle hovercraft ferry service across the English Channel in 1968.

In addition, British Rail Hovercraft Limited has also ordered one SR.N4. British hovercraft have so far seen commercial service in the United States, Scandinavia, U.K. and the Far East and they have logged a total mileage equivalent to thirty times around the equator.

The longest-established scheduled ferry service is operated by Hovertravel Limited between Ryde on the Isle of Wight and Gosport and Southsea on the mainland. Since the service started in July, 1965, almost half a million passengers have been carried by the two SR.N6's operating along these routes.

As an all-passenger ferry, the 40-ton (40,6 tonnes) BH.7 will accommodate 180 people and as a passenger/car ferry, 70 people and 8 cars. Its freight capacity will be 18 tons (18,3 tonnes). The larger BH.8 will have a passenger capacity of 280, a composite load capacity of 110 passengers and 14 cars and a freight capacity of 35 tons (35,6 tonnes).

The current development programme has as its ultimate target the production of a 300-ton (304,8 tonnes) hovership with an open-water capability, fairly long range and a considerable load-carrying capacity. Already, it is possible to extrapolate present technology to project a 4,000-ton (4064,2 tonnes) ocean-going hoverfreighter with an open-sea range of 2,000 nautical miles (3.680 km).

SR.N4

The 165-ton SR.N4 is a fast passenger/car ferry designed for operations on 'open-sea' routes.
Interior layout can be varied to suit operators' requirements. Typical layouts include all-passenger versions carrying 500 people seated or 700/800 passengers on short routes, and a passenger/car version carrying 256 people seated and 30 cars. In addition, SR.N4 can be used to carry freight.

Large doors in the bow and stern greatly facilitate loading and unloading, and give extremely short 'turn-round' times. Fitted with 8 ft. skirts, SR.N4 will be capable of operating in 10 ft. seas, normally the most severe encountered on open-water routes such as the English Channel. Being truly amphibious, SR.N4 can operate from relatively simple bases located above the high-water mark and away from congested port areas, irrespective of the state of the tide and the water depth. This greatly reduces capital costs as well as increasing operational flexibility. Operation from existing harbour installations involves a minimum of alteration.

Two SR.N4's have been ordered by Hoverlloyd for use on a passenger/car ferry service between Ramsgate and Calais in 1968. British Rail have also ordered a single SR.N4 scheduled for delivery early next year.

Leading Particulars

Dimensions	
Overall length	130′ 2″ (39,68 m)
Overall beam	76′ 10″ (23,46 m)
Overall height on landing pads	42′ 5″ (12,95 m)
Vehicle deck headroom (on centre line)	11′ 3″ (3,4 m)
Bow ramp aperture (height x width)	11′ 6″ x 18′ (3,5 m x 5,5 m)
Stern door aperture	31′ x 11′ 6″ (9,5 m x 3,5 m)
Skirt length – basic craft	8′ (2,5 m)
Weights	
Disposable load	63·5 tons (64,5 tonnes)
Normal gross weight	165 tons (167,6 tonnes)
Maximum gross weight	185 tons (187,9 tonnes)
Power plant and systems	
Main engines	4 Bristol Siddeley 'Marine Proteus'
Maximum continuous rating at I.S.A.C.	4 x 3,400 s.h.p. (4 x 3.447 cv)
Auxiliary power units	2 Rover IS/90 gas turbines
Propellers	4 four-blade, variable-pitch 19′ dia. (5,8 m)
Lift fans	4 B.H.C. centrifugal 11′ 6″ dia. (3,5 m)
Fuel capacity	4,500 Imp. gallons (20.456 litres)
Performance (at normal gross weight) under I.S.A. conditions	
Maximum speed over calm water (maximum power)	77 knots (143 km/hr)
Maximum speed over calm water (maximum continuous power)	70 knots (130 km/hr)
Airspeed in 4′–5′ (1,2–1,5 m) waves into wind	55–65 knots (102–120 km/hr)
Airspeed in 8′–10′ (2,4–3,0 m) waves into wind	50–60 knots (93–111 km/hr)
Still-air range (max. fuel)	290 n. miles (540 km)

SR.N5

The SR.N5 is a small, high-performance hovercraft with a wide range of applications. It was the first hovercraft to be put into quantity production in the world, and since production began, contracts have been received from Norway, United States, Germany, Japan, United Kingdom and Brunei.

Capable of carrying 18 passengers or 2–3 tons (2,1–3,1 tonnes) of freight, SR.N5 is based on a 15 in. (38 cm) deep buoyancy tank, subdivided into watertight compartments. The cabin, positioned forward, is set into the plenum chamber and buoyancy tank. A hinged bow door gives easy access to the cabin.

The craft is controlled by rudders and elevators mounted on the twin-fin tailplane unit, which operates in the propeller slipstream. A skirt-lifting system provides extra control, particularly at low speeds.

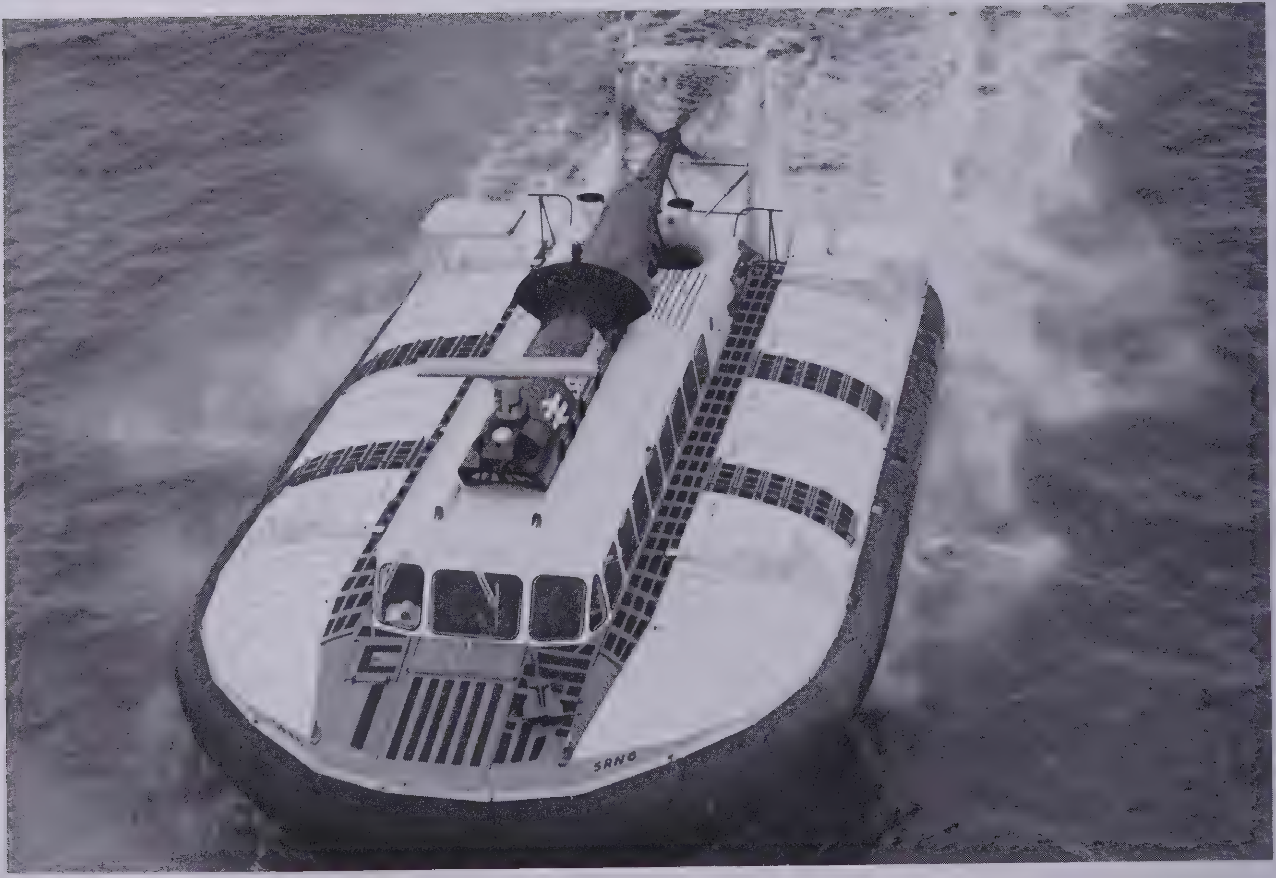
Fitted with 4 ft. (1,2 m) skirts, SR.N5 has an outstanding rough-country and overwave performance. Its amphibious capabilities enable the craft to operate over ice, sand, mud flats and debris-strewn waters. It is a particularly attractive vehicle for military duties, where its excellent power-to-weight ratio gives it exceptional operational adaptability. SR.N5 is being operated by the British Armed Services and the U.S. Navy.

Leading Particulars

Dimensions	
Overall length	38′ 9″ (11,8 m)
Overall beam	23′ (7,0 m)
Overall height on pads	12′ 11″ (3,9 m)
Weights	
Basic weight	4·1 tons (4,2 tonnes)
Normal gross weight	6·6 tons (6,7 tonnes)
Power plant and systems	
Engine	One Bristol Siddeley 'Marine Gnome' turbine (900 s.h.p. maximum continuous power)
Propeller	Dowty Rotol four-blade variable-pitch 9′ dia. (2,8 m)
Lift fan	B.H.C. centrifugal 7′ dia. (2,1 m)
Fuel	Standard Kerosene
Fuel capacity	265 Imp. gallons (1.205 litres)
Performance	
Maximum speed over calm water (maximum power)	66 knots (120 km/hr)
Maximum speed over calm water (maximum continuous power)	62 knots (113 km/hr)
Speed in 4′–5′ (1,2–1,5 m) waves	40–50 knots (74–92 km/hr)
Endurance	3·6 hrs

Typical uses

Passenger ferry
Freight carrier
High-speed search and rescue
Survey and exploration
Military logistic support


SRN6

SR.N6

The SR.N6 is a high-performance overwater passenger ferry hovercraft employing a single engine, lift fan and propeller, and is currently in full-scale production.

Its design incorporates many of the fully-developed systems and components used in the highly-successful SR.N5. This extensive use of proven components, coupled with increased payload (achieved without an increase in installed power), has resulted in greatly-improved operating economics.

SR.N6 can accommodate 38 passengers in its roomy cabin, which can be readily adapted to carry an alternative load of 3 tons (3,1 tonnes) of freight.

Being truly amphibious, it can operate from relatively unsophisticated bases situated above the high-water mark, irrespective of the state of the tide and the depth of the water. The craft is controlled by 2 rudders and all-moving elevators incorporated in the twin-fin tailplane assembly, plus auxiliary air ducts. Manoeuvrability is further improved by a 'lifting' system fitted to the flexible skirts.

During 1965, SR.N6's were introduced on passenger ferry services by Scanhover A/S in Norway and Denmark, Clyde Hover Ferries Ltd. in Scotland, and Hovertravel Ltd. in England. Further SR.N6's entered service with Hoverlloyd on the Ramsgate/Calais route in May, and with Townsend Car Ferries Ltd. in the Dover/Deal/Folkestone area. British Rail also started operations with two SR.N6's in the Solent.

An SR.N6 has also been delivered to Shell (Brunei) Ltd. for operation to offshore oil installations – the first time a hovercraft has been used anywhere for this type of work.

Leading Particulars

Dimensions

Overall length	48′ 5″ (14,8 m)
Overall beam	23′ (7,0 m)
Overall height on landing pads	15′ (4,6 m)
Cabin size (length x beam)	21′ 9″ x 7′ 8″ (6,6 m x 2,3 m)
Cabin floor area	166 sq. ft. (15,4 sq. m)
Door aperture size (height x width)	5′ 9″ x 3′ 3″ (1,7 m x 1,0 m)
Skirt length	4′ (1,2 m)

Weights

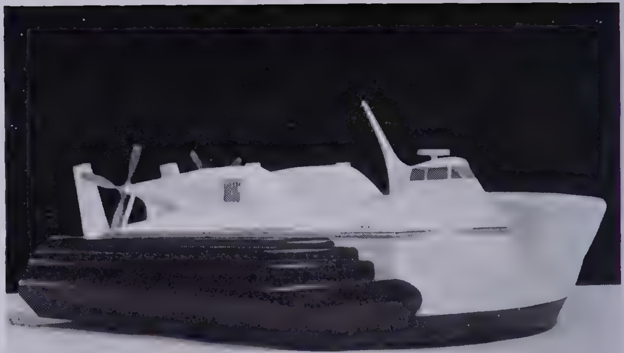
Normal gross weight	8·9 tons (9,1 tonnes)
Maximum gross weight	10·3 tons (10,5 tonnes)

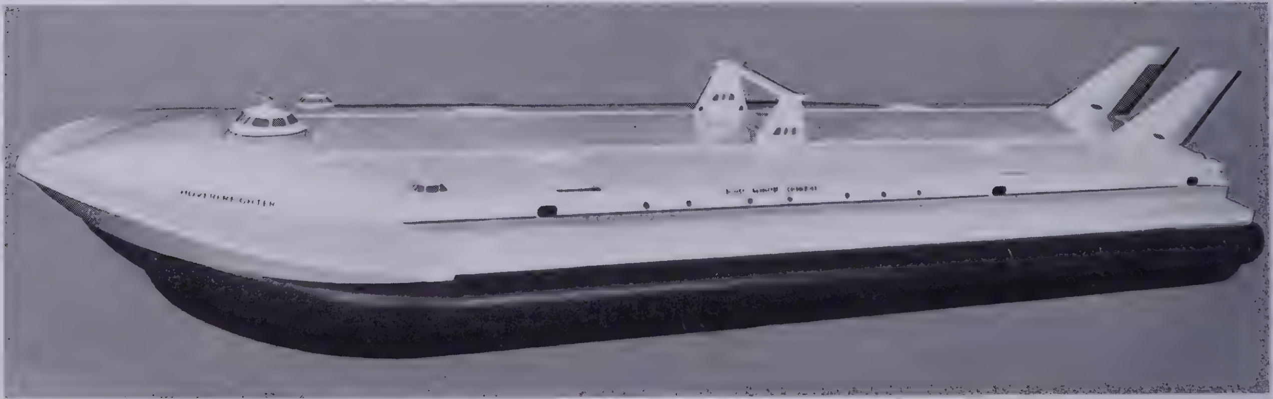
Power plant and systems

Engine	Bristol Siddeley 'Marine Gnome' gas turbine
Maximum continuous rating at I.S.A.C.	900 s.h.p.
Propeller	Dowty Rotol four-blade variable-pitch 9′ dia. (2,7 m)
Lift fan	B.H.C. centrifugal 7′ dia. (2,1 m)
Fuel capacity	265 Imp. gallons (1.205 litres)

Performance (at 17,300 lb. operating weight (7.847 kg) under I.S.A. conditions)

Maximum speed over calm water (maximum power)	60 knots (111 km/hr)
Maximum speed over calm water (maximum continuous power)	56 knots (104 km/hr)
Speed in 4′–5′ (1,2–1,5 m) waves	45–55 knots (83–102 km/hr)
Still-air range	200 n. miles (370 km)





BH.7

The BH.7 is a 40-ton (40,6 tonnes) open-water craft suitable for a wide variety of commercial and military applications.

The Ministry of Defence has already announced its intention to order two military variants of these craft subject to satisfactory negotiations. Powered by a single 3,400 s.h.p. Bristol Siddeley 'Marine Proteus' engine, this 70 ft. (21,3m) craft can achieve a maximum continuous calm water speed of 70 knots (133 km/hr) and is capable of 40/50 knots (74/94 km/hr.) in 4/5 ft. (1,2/1,5m) waves. As a commercial craft at a gross weight of 45 tons (45,7 tonnes) it can carry either 180 passengers, or 72 passengers and 8 cars or 18 tons (18,3 tonnes) of freight.

(top left-hand corner)
Artist's impression of the 40-ton BH.7.

(top right-hand corner)
Model of the 80-ton BH.8.

(bottom)
Model of the 4,000-ton ocean-going hoverfreighter.

BH.8

The 80-ton (81,2 tonnes) BH.8 is an open-water craft with bow and stern loading facilities.

Powered by twin 3,400 s.h.p. Bristol Siddeley 'Marine Proteus' gas turbine engines, it has a maximum continuous calm water speed of 75 knots (139 km/hr) and is capable of 45/55 knots (84/102 km/hr) in 4/5 ft. (1,2/1,5 m) waves.

At a typical commercial gross weight of 90 tons (91,4 tonnes), its spacious interior can accommodate either 280 passengers, or 110 passengers and 14 cars or 35 tons (35,6 tonnes) of freight.

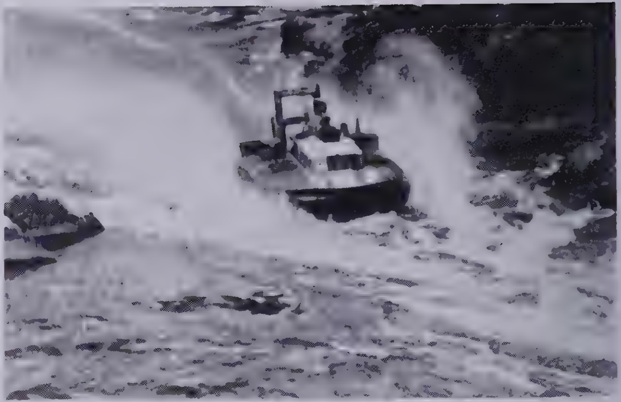
As a military craft, it is ideally suited for logistic support operations, being capable of carrying laden Army lorries. The BH.8 is also the largest hovercraft that can be readily transported in one piece as deck cargo, thus facilitating world-wide delivery.

HOVERFREIGHTER

The current five year development programme now being conducted by B.H.C. has as its ultimate target a 300-ton (304,8 tonnes) hovership with an open-water capability, a fairly long range and considerable load-carrying capacity. It is, however, possible even at this early stage to extrapolate present technology to project a hoverfreighter of 4,000 tons (4.064,2 tonnes).

This container-carrying craft would have a very large work capacity and would be capable of operating in almost all weather conditions. Being water-propelled, it would be confined to overwater operations. It would be powered by eight 18,500 s.h.p. Bristol Siddeley 'Olympus' gas turbines. Special loading and unloading gantries and roller-track links would ensure rapid turnaround and allow freight to be transferred directly to road and rail transport.

MILITARY HOVERCRAFT



Although the accent to date has been on the commercial exploitation of hovercraft, military authorities in the U.K. and the U.S.A. have been actively investigating their military potential in a wide variety of amphibious and overwater roles for some time now.

The great success of trials conducted by the British Interservice Hovercraft Trials Unit, was reflected in the Army's decision to form a Hovercraft Unit equipped initially with four military variants of the SR.N6. Following close upon this decision came a statement from the Ministry of Defence revealing its intention to order two new B.H.C. prototypes. Designated BH.7, these 40-ton craft will be capable of carrying 15-ton payloads across areas of open water such as the North Sea and English Channel, at speeds of over 40 knots. The significance of both these decisions lies mainly in the fact that for the first time, hovercraft will attain full military operational status.

The intensive IHTU trials programme which led up to these announcements, was carried out by three military variants of the 7-ton SR.N5 and the world's largest hovercraft, the 37-ton SR.N3.

Troops wait to board the 37-ton SR.N3 as three Landrovers are unloaded during 'Hovershow '66'.

An SR.N5 of the Hovercraft Unit (Far East) shooting the turbulent Pelagus Rapids near Sibu in Malaysian Borneo (Crown copyright reserved).

SR.N3 coping smoothly with gale-force winds and rough seas during trials in the Solent (Air-Cushion Vehicles photo).

SR.N5 delivering supplies and equipment to a forward area post in the Borneo jungle (Air-Cushion Vehicles photo).

This latter craft has spent most of its operational life in home waters undergoing evaluation in anti-submarine warfare, coastal patrolling and amphibious assault roles.

Two of the three SR.N5's, however, have seen service in many different parts of the world. Early in 1966, they returned from the Far East where they had been operating in conjunction with British Security Forces. Their duties included replenishment missions to inland bases, and off-shore patrolling. Before their return to the U.K., both craft took part in extensive overland trials in Thailand.

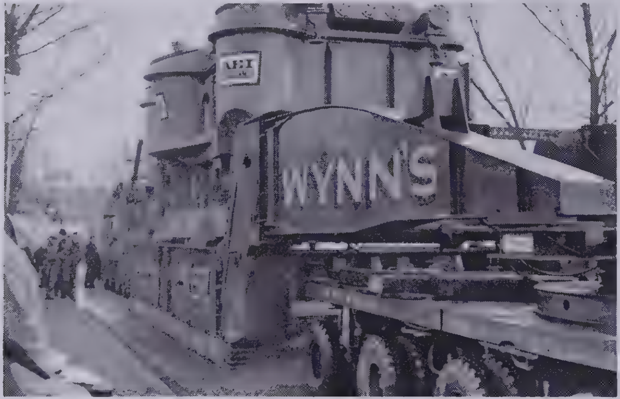
The third SR.N5 has been primarily involved in fire-fighting and crash rescue duties; roles in which the R.A.F. are particularly interested. Other areas in which these SR.N5's have operated include the hot dusty deserts of Aden and the ice-bound terrain of Arctic Canada.

Apart from the U.K., interest in the U.S.A. is running at a high level and three SR.N5's (U.S. designation SK.5) have seen front-line service with the United States Navy in the Mekong Delta area of Vietnam on patrol duties. The tremendous successes achieved during military trials held to date virtually assure the hovercraft a place in future military strategy.

Currently under development alongside the BH.7 is the BH.8, an 80-ton open-water craft with bow and stern loading and unloading facilities. As a military craft, it is ideally suited for logistic support operations.

B.H.C. is also going ahead with a five-year programme which has as its ultimate target, the production of a 300-ton (304,8 tonnes) hovership designed for naval use, and many other proposals to meet future military requirements, are now on the drawing boards.

NON-MARINE APPLICATIONS OF A.C.V'S.



Apart from its work on civil and military overwater hovercraft, B.H.C. is also investigating several other possible applications of the air-cushion principle.

Heavy-Load Transporter

This vehicle greatly facilitates the movement by road of very heavy equipment such as electricity transformers, by distributing more evenly, the loads imposed on bridges. For example, a standard transporter with a payload limitation of 150 tons for a 50 ft. single-span bridge, could safely cross with a 215-ton load if an air cushion were incorporated.

The development of the air-cushion transporter was prompted initially by the Central Electricity Generating Board, which has already received conversion equipment for one vehicle. With the demand for electricity building up rapidly, ever-larger transformers will be needed. Units now going into service weigh between 190 and 250 tons, and 300-ton units are already in prospect. Even now, the very high gross weights of loaded transporters pose considerable route-planning problems. On occasion, the Board has faced the heavy expense of strengthening, or even rebuilding, bridges when no suitable route could otherwise be found. The even costlier alternative would have been to break the transformer down into smaller units.

The air cushion supports the centre, payload-carrying, section of the transporter trailer. Its flexible container can be quickly detached and folded for stowage when the air cushion is not needed, or when it might suffer damage – as, for example, when the transporter is negotiating sharp bends. Power for the cushion is provided by 4 Rolls-Royce petrol engines together giving 235 h.p. at 4,000 r.p.m., which are housed in a separate, sound-proofed vehicle which also provides stowage for the air-cushion container when it is not in use.

To avoid possible damage to bridges through sudden fluctuations in cushion pressure, this is controlled automatically to very close tolerances. Should one of the four power sources fail, it is automatically sealed off. In normal operation, 25% of the air supply is blown to waste, but in the event of power-unit failure, this is automatically diverted into the cushion, thus maintaining a constant cushion pressure.

The whole air-cushion system is soundproofed to satisfy stringent limitations on noise-level, laid down by the Ministry of Transport.

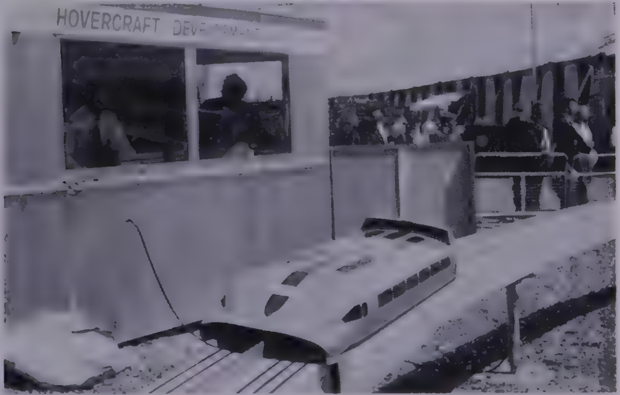
(opposite page)
The CEGB Heavy Load Transporter using its air-cushion equipment for the first time in commercial service crossing the Felin Puleston Bridge in North Wales with a 155-ton load. Use of the equipment reduced stress on the bridge by 70 tons.

The air-cushion equipment retracted for normal road use.

Close-up of the air-cushion equipment inflated whilst crossing the Felin Puleston Bridge.

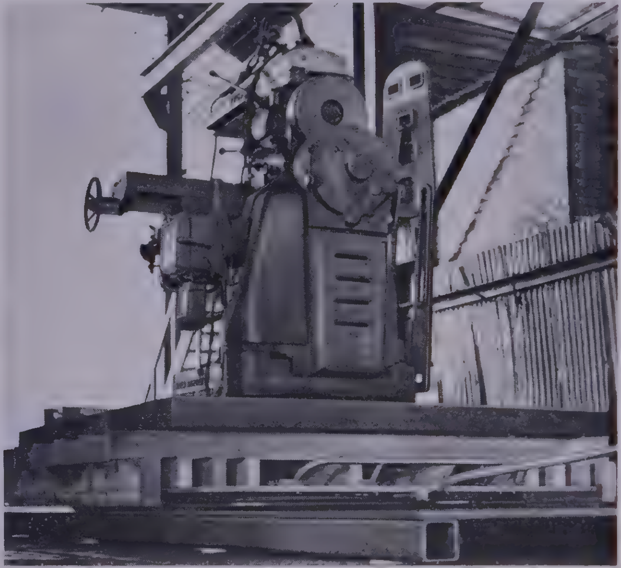
TRACKED HOVERCRAFT

This is an overland transport system operating over a prepared track, for both high-speed inter-city, and low-speed, short-journey transportation. The ability of the high-speed vehicle to start and complete journeys in city centres, combined with a high average speed, will lower the total time for journeys of up to 500 miles to below that attainable by airline travel. The slower, smaller versions of the vehicle will be much faster than conventional transport and will provide a very high-frequency service. The studies of the Tracked Hovercraft Group of Hovercraft Development Limited have shown the system to be technically feasible and economically attractive, and fares would be comparable with the cost of present-day rail travel. Tracked Hovercraft will be fitted with a completely automatic and fail-safe control system that will enable them to operate under all weather conditions, even zero visibility. Continuous work is being done on this project, with full-scale investigation planned as the next step forward.



HOVERPALLETS

These are simple air-cushion units designed to facilitate the movement of heavy loads such as machinery in factories and warehouses, and the rapid storage of containers and pallets in ships' holds. Their use will, in many instances, enable such loads to be handled manually, whereas now, cranes and other specialised equipment are needed.



(left)
A model of the 300 m.p.h. 'Hovertrain' projected by Hovercraft Development Limited.

(above)
$4\frac{1}{2}$ tons under finger-tip control. A large machine tool literally floating on air on one of the 'Flotaload' hoverpallets now being put into production by BHC. The use of the air cushion allows this heavy load to be moved about by just one man.

Members of the B.H.C. Board are:

E. C. WHEELDON, C.B.E. *Chairman*
D. C. COLLINS *Managing Director*
R. STANTON JONES *Deputy Managing Director*
W. OPPENHEIMER *Ass. Man. Dir. (Finance)*
L. BODDINGTON, C.B.E. *Ass. Man. Dir. (Technical)*
R. F. DUNLOP *Commercial Director*
E. F. GILBERTHORPE *Works Director*

Non-Executive members of the Board are:

R. P. H. YAPP
W. D. OPHER
J. H. ROBBIE
J. C. DUCKWORTH
HENNESSEY

Pam. 629.1.039. B.H.C L. 13

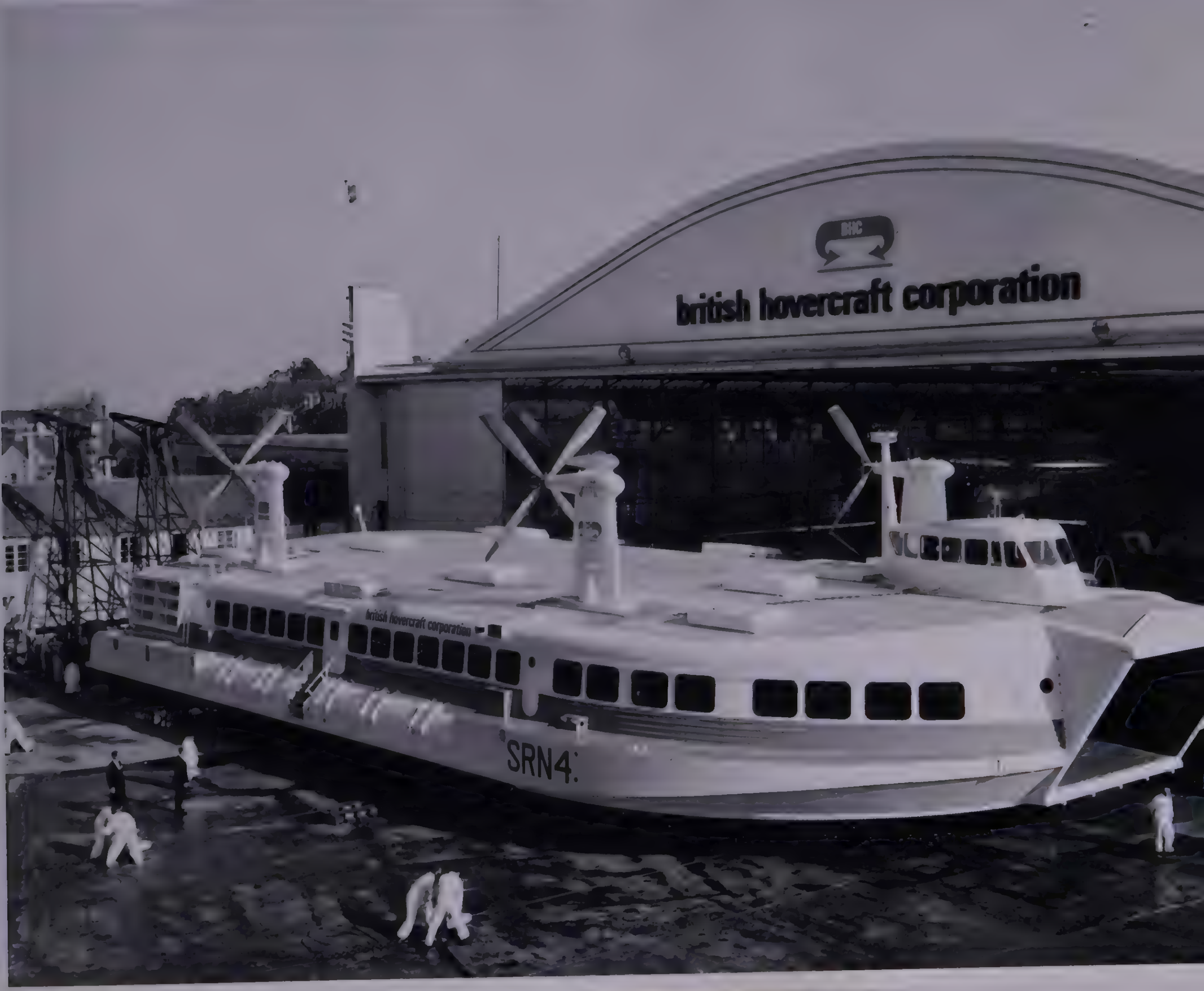
POLAR
PAM
4646

POLARPAM

BHC
british hovercraft corporation limited
YEOVIL ENGLAND
TELEPHONE YEOVIL 5222 · TELEX 4677 · TELEGRAMS AIRCRAFT TELEX YEOVIL

THE BOREAL INSTITUTE
LIBRARY
DEC 13 1967

EDWIN SNELL & SONS, PRINTERS, YEOVIL, ENGLAND


BHC
british hovercraft corporation
british hovercraft corporation
SRN4

B.1482

BRITISH HOVERCRAFT CORPORATION

The first SR.N4 passenger/vehicle ferry hovercraft immediately after being wheeled out for the start of engine runs and system checks at BHC's Cowes, Isle of Wight Plant on October 26th, 1967.

With the compliments of
BHC Public Relations,
Westland Works,
Yeovil, Somerset.

October 1967

Tel : Yeovil 5222 Ext. 371

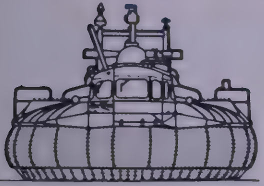
B.H.C. 81

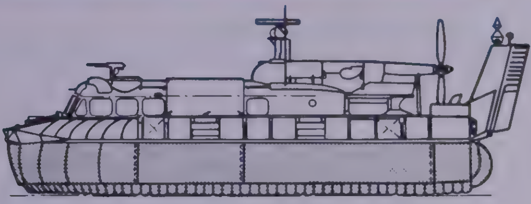
THE BOREAL INSTITUTE
LIBRARY

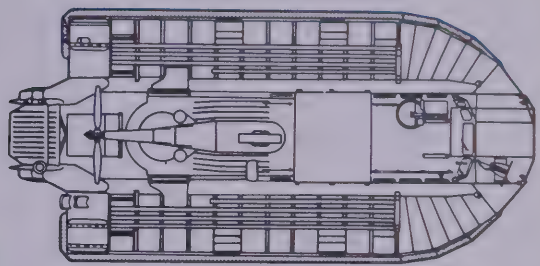
DEC 13 1967

SR.N6

military







Pam. 629.1.037

The SR.N6 (Military) is a high-performance amphibious hovercraft employing a single engine and an integrated lift and propulsion system. It is in current production. Being truly amphibious, it can operate from relatively unsophisticated bases situated above the high water mark, irrespective of the state of the tide and the depth of the water. It can operate in shallow waters, over marshes and sand-bars, along rivers and through rapids, and over ice and snow.

Incorporating the fully developed systems and components of the SR.N6 already in passenger-ferry service, the design of the SR.N6 (Military) differs mainly in having a large top-hatch and a wider bow door. Thus, military weapons, equipment and stores can be loaded and unloaded either by overhead crane or through the bow. As a further facility, palletised loads can be 'floated' in and out on hover-pallets supplied with air from the main engine compressor. Loads of up to ½ ton which are too long for the cabin may be secured on the strengthened decking each side.

Directional control is achieved by two rudders and all-moving tailplanes plus an auxiliary air-porting system. Manœuvrability is further improved by a 'lifting' system fitted to the flexible skirt.

A roof hatch gun position is located on the port side of the cabin. Armour plating protects the engine and vital electrical components and there are fittings to accept extra armour to give protection for 20 troops sitting on the cabin floor against 7,62 mm ammunition. The floor has 22 lashing points for securing loads. A small auxiliary electrical generator unit is fitted for use when electrical power is required for prolonged periods while the main engine is stopped. Communication equipment is grouped together behind the rear cabin bulkhead, with doors for easy access.

Typical uses	**Typical military loads**
Logistic support	30 armed troops
Troop and weapon carrying	105 mm howitzer and crew
Coastal Patrolling	120 mm anti-tank gun and crew
Casualty evacuation	3 NATO Pallets

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited.

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

Publication No. SP 144 2 Issue 2 May 1967 Printed in England

LEADING PARTICULARS

	DIMENSIONS—overall
Length	48′ 5″ (14,76 m.)
Beam	23′ 0″ (7,01 m.)
Height on landing pads	14′ 11″ (4,55 m.)
Skirt length	4′ 0″ (1,22 m.)
	DIMENSIONS—internal
Cabin length	19′ 0″ (5,78 m.)
Cabin width	7′ 6″ (2,29 m.)
Headroom—centre line	6′ 0″ (1,83 m.)
Door height	5′ 0″ (1,52 m.)
Door width	4′ 3″ (1,29 m.)
Roof hatch length	7′ 0″ (2,13 m.)
Roof hatch width	7′ 6″ (2,29 m.)
	WEIGHTS
Basic	6 tons (6,1 tonnes)
Normal gross	10 tons (10,2 tonnes)
Maximum (overload)	11 tons (11,2 tonnes)
	POWER PLANT AND SYSTEMS
Main engine	Bristol Siddeley Marine 'Gnome' 1051 at 900 s.h.p. maximum continuous power
Auxiliary power unit	Petter DA.1 diesel engine, 6½ h.p.
Fan	BHC 12-bladed, centrifugal, 7′ 0″ (2,13 m.) dia.
Propeller	Dowty Rotol 4-bladed, variable pitch, 9′ 0″ (2,74 m.) dia.
Fuel capacity (normal)	265 Imp. gall. (1.205 litres)
	PERFORMANCE (at 7·7 tons operating weight, I.S.A. conditions)
Maximum speed, calm water (maximum power)	60 knots (111 km./hr.)
Maximum speed, calm water (maximum continuous power)	56 knots (104 km./hr.)
Speed in 4–5 ft. waves (1,2–1,5 m.) (airspeed into wind)	45–55 knots (83–102 km./hr.)
Endurance (normal fuel)	3¼ hours

POLAR
PAM
4646

POLARPAM

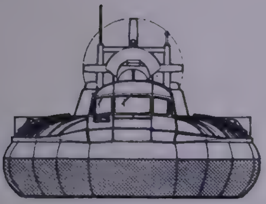
BHC
british hovercraft corporation limited
YEOVIL, ENGLAND

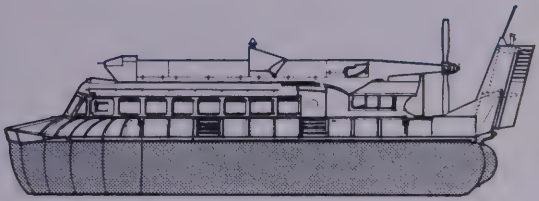
B.H.C. L.23

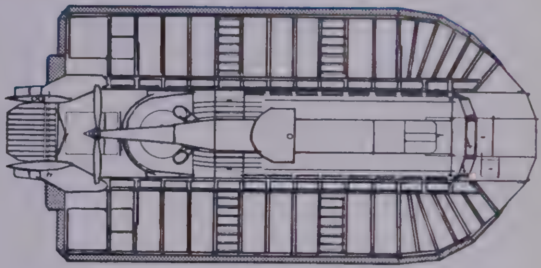
THE BOREAL INSTITUTE
LIBRARY

DEC 13 1967

SR.N6







Pam. 629.4.039

The SR.N6 is a high-performance overwater passenger ferry hovercraft employing a single engine, lift fan and propeller and is currently in full scale production.

Incorporated into its design are many of the fully-developed systems and components used in the highly successful SR.N5. This extensive use of proven components coupled with the increased payload capability (achieved without an increase in installed power), has resulted in improved operating economics.

Designed primarily as a passenger transport, the SR.N6 can accommodate 38 passengers in its roomy cabin which can be readily adapted to carry an alternative load of 3 tons of freight.

Power for its integrated lift/propulsion system is provided by a Bristol Siddeley 'Marine Gnome' BS GN 1051 gas turbine engine with a maximum continuous rating of 900 s.h.p. In calm seas, the SR.N6 has a maximum cruising speed of up to 56 knots. At reduced speeds, it can operate in waves up to at least 5 ft. in height.

Being truly amphibious, it can operate from relatively unsophisticated bases situated above the high-water mark, irrespective of the state of the tide and the depth of the water. Directional control is achieved by two rudders and all-moving tailplanes incorporated in the twin fixed fin assembly, plus an auxiliary air-porting system. Manoeuvrability is further improved by a 'lifting' system fitted to the flexible skirts.

During 1965 a number of SR.N6's were introduced on passenger ferry services in Scandinavia and United Kingdom. Further services were launched during 1966 including two across the English Channel.

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

Publication No. SP 1055 Issue 5 May 1967 Printed in England

LEADING PARTICULARS

	DIMENSIONS
Overall length	48′ 5″ (14,76 m.)
Overall beam	23′ (7,01 m.)
Overall height on landing pads	15′ (4,57 m.)
Cabin size (length × beam)	21′ 9″ × 7′ 8″ (6,62 m. × 2,34 m.)
Cabin floor area	166 sq. ft. (15,42 sq. m.)
Door aperture size (height × width)	5′ 9″ × 3′ 3″ (1,75 m. × 0,99 m.)
Skirt length	4′ (1,22 m.)
	POWER PLANT AND SYSTEMS
Engine	Bristol Siddeley Marine 'Gnome' 1051
Max. continuous rating at 15° c	900 s.h.p.
Propeller	Dowty Rotol, 4-blade, variable pitch, 9 ft. dia. (2,74 m.)
Lift fan	BHC centrifugal, 7 ft. dia. (2,13 m.)
Fuel capacity	265 Imp. gall. (1.205 litres)
	WEIGHTS
Normal gross weight	8·9 tons (9,1 tonnes)
Max. gross weight	10·3 tons (10,5 tonnes)
	PERFORMANCE (at 17,300 lb. operating weight (7.847 kg) at 15° c
Maximum speed over calm water (max. power)	60 knots (111 km/hr)
Maximum speed over calm water (max. cont. power)	56 knots (105 km/hr)
Speed in 4–5 ft. waves	45–55 knots (83–102 km/hr)
Still air range	200 n. miles (370 km)

POLAR
PAM
4646

POLARPAM

british hovercraft corporation limited
YEOVIL, ENGLAND

B.H.C. L.24

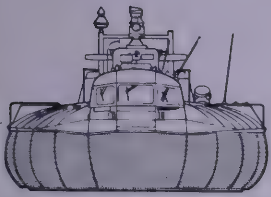
Pam. 629.1.039

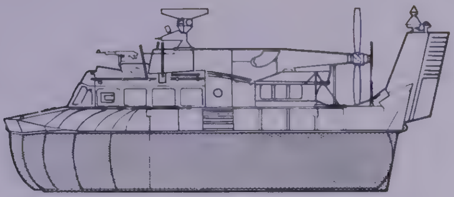
THE BOREAL INSTITUTE
LIBRARY

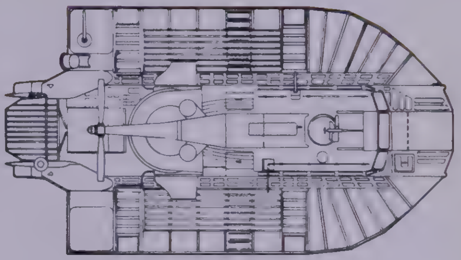
DEC 13 1967

SR.N5

fast interceptor







The SR.N5 (Fast Interceptor) is a high performance amphibious hovercraft employing a single engine and an integrated lift and propulsion system. Being truly amphibious, it can operate from relatively unsophisticated bases situated above the high water mark, irrespective of the state of the tide and the depth of the water. It can operate in shallow waters, over marshes and sand-bars, along rivers and through rapids, and over ice and snow.

Already numbers of this type of craft have seen service with British forces in Borneo and with American forces in Vietnam, carrying out tasks impossible using existing, conventional vehicles.

A roof hatch gunring, mounting a 7.62 mm general purpose machine gun is located centrally on the cabin. Armour plating protects the engine and vital electrical components and there are fittings to accept extra armour to give protection against 7.62 mm ammunition for troops sitting on the cabin floor. A small auxiliary electrical generator unit is fitted for silent watch and when electrical power is required for prolonged periods while the main engine is stopped. The radar and radio installation is well up to the requirements of this role. The craft may be required for logistics work and lashing points for securing loads are provided in the floor.

Full air conditioning is fitted together with cooking and toilet facilities. Extended range tanks enable six fully armed troops to be carried on day and night patrols involving up to 7 hours operation at maximum continuous speed.

Typical uses: **Anti-smuggling Patrol**
Coastal and River Surveillance
Anti-infiltration Patrol
Tactical Deployment

Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with The British Hovercraft Corporation Limited

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

Publication No. S.P.1579 Issue 1 April 1967 Printed in England

LEADING PARTICULARS

	Dimensions
Overall length	38′ 9″ (11,78 m).
Overall beam	23′ (7,01 m.)
Overall height on pads	14′ 11″ (4,53 m.)
	Weights
Basic weight	4.95 tons (5,030 kg.)
Normal gross weight	7.70 tons (7,830 kg.)
Overload weight	8.80 tons (8,950 kg.)
	Power plant and systems
Engine	One Bristol Siddeley Marine 'Gnome' engine 900 shp max. cont. power
Propeller	Dowty Rotol 4-blade variable pitch, 9 ft. dia. (2,74 m.)
Lift fan	Westland centrifugal 7 ft. dia. (2,13 m.)
Fuel	Standard kerosene
Fuel capacity	265 Imp. gall. (1,205 litres)
Extended range capacity	220 Imp. gall. (1,025 litres)
	Performance
Maximum speed over calm water (max. power)	63 knots.
Maximum speed over calm water (max. cont. power)	60 knots
Calm water practical range	205 n. miles
Calm water extended range	395 n. miles
Max. endurance	7.0 hours
Max. gradient at static conditions	1 in 6

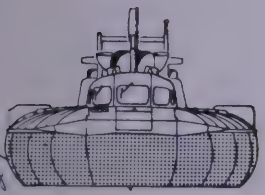
BHC
YEOVIL ENGLAND british hovercraft corporation limited

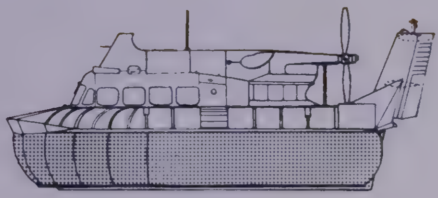
THE BOREAL INSTITUTE
LIBRARY
DEC 13 1967

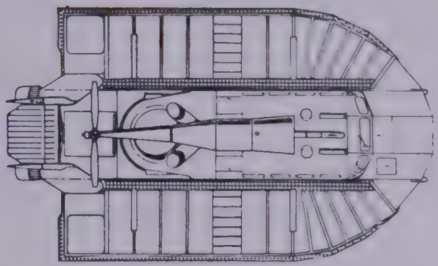
B.H.C. L.33

PAM. 629.1.039

SR.N5







The SR.N5 is a small high-performance hovercraft with a wide range of applications. It was the first hovercraft to be put into quantity production in the world and in advance of orders. Since production commenced orders have been received from Norway, United States, Germany, Japan, Brunei and United Kingdom.

Weighing 7 tons and capable of carrying 18 passengers or 2 tons of freight, the SR.N5 design is based on a 15-inch deep buoyancy tank, sub-divided into watertight compartments. The cabin, positioned forward, is set into the plenum chamber and buoyancy tank. Easy access to the cabin is by a bow-loading door.

Power for propulsion and the air cushion lift is provided by a Bristol Siddeley 'Marine Gnome' engine which is situated to the rear of the cabin. By a simple mechanical system, the engine is coupled to a single lifting fan and a variable pitch propeller. Control of the craft is by rudders and elevators mounted on the twin fin/tailplane unit, which operates in the propeller slipstream. A skirt lifting system is also provided to give extra control, particularly at low speeds.

Fitted with 4-foot skirts the SR.N5 has an outstanding rough-country and overwave performance. Its amphibious capabilities enable the craft to operate over ice, sand and mud flats and debris-strewn waters. It is a particularly attractive vehicle for military duties, where its excellent power to weight ratio gives it exceptional operational adaptability. SR.N5 is being operated by the British Military Services and the U.S. Navy.

LEADING PARTICULARS

	DIMENSIONS
Overall length	38′ 9″ (11,78 m.)
Overall beam	23′ (7,01 m.)
Overall height on pads	12′ 11″ (3,96 m.)
	WEIGHTS
Basic weight	4·06 tons (4. 124 kg)
Normal gross weight	6·57 tons (6. 686 kg)
	POWER PLANT AND SYSTEMS
Engine	One Bristol Siddeley Marine 'Gnome' engine 900 s.h.p. max. cont. power
Propeller	Dowty Rotol 4-blade variable pitch, 9 ft. dia. (2,74 m.)
Lift fan	BHC centrifugal 7 ft. dia. (2,13 m.)
Fuel	Standard kerosene
Fuel capacity	265 Imp. gall. (1.205 litres)
	PERFORMANCE (at 15 c)
Maximum speed over calm water (max. power)	66 knots (120 km./hr.)
Maximum speed over calm water (max. cont. power)	62 knots (113 km./hr.)
Calm water practical range	205 n. miles (380 km)
Endurance at max. cont. power	3·6 hours
Max. gradient at static conditions	1 in 6

TYPICAL USES

- Passenger ferry
- Utility freight carrier
- High speed search and rescue craft
- Weed and pest control
- Survey and exploration craft
- Logistic support military craft

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited

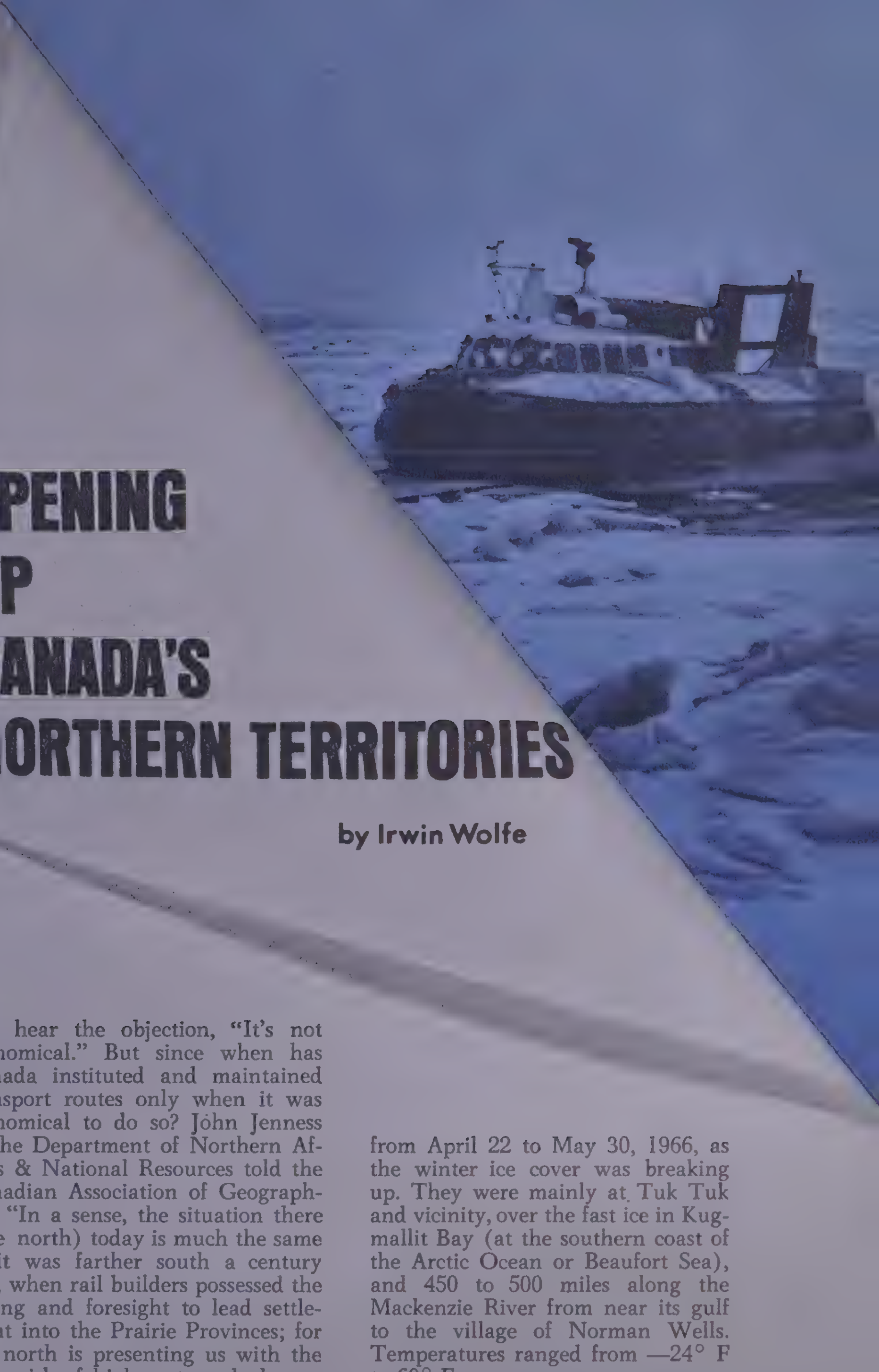
British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

Publication No. SP 802 Issue 6 May 1967 Printed in England

WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

BHC
british hovercraft corporation limited
YEOVIL, ENGLAND

Pam. 629.1 039
B.H.e L.4



OPENING UP CANADA'S NORTHERN TERRITORIES

by Irwin Wolfe

DOES the Canadian Government possess a fortune in its North, or does it possess a million-and-a-half square miles of frozen, useless geography located at the top of the world?

The experts are betting that Canada's northland can become truly wealthy by exploiting the vast resources lying beneath the northern surface. Rich oil reserves lie beneath Cornwallis Island, Bathurst Island and the Mackenzie River district. Because of today's poor transportation, however, it is only feasible now to mine areas in the southern strip of the territories, where they border the provinces.

Recent improvements to existing modes of transport, and the development of a new mode—the air cushion vehicle—have set a good many Canadians to wondering just where Canada goes from here with its northland.

The C-130 or Hercules aircraft is now in regular supply operations in the North with the Royal Canadian Air Force. Snowmobiles are in more frequent use, even by the Eskimo. Another step forward was taken last year. Canada staged two trials of ACVs, one at Tuktoyaktuk and on the Mackenzie River, the other at Trenton, Ont.

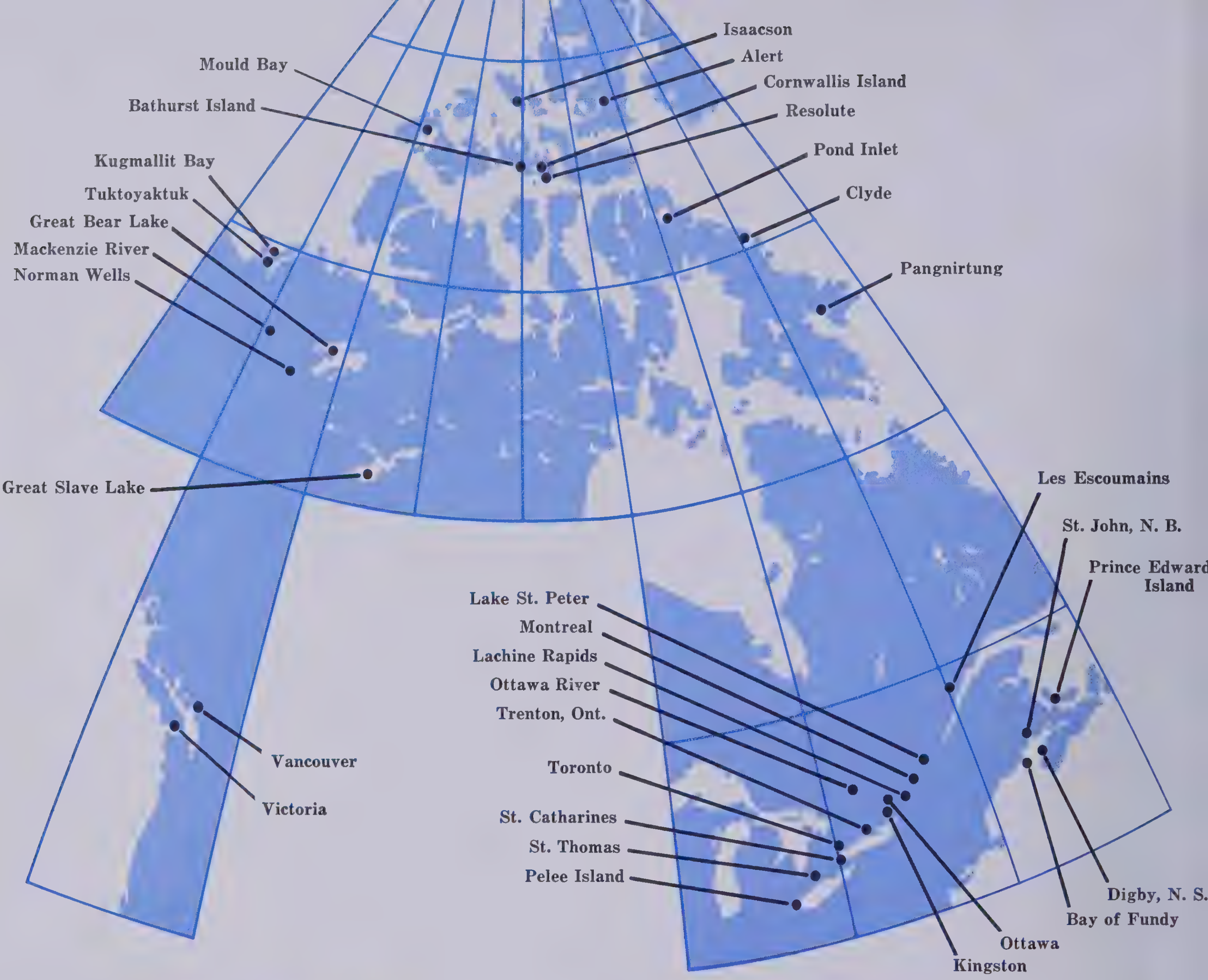
Concerning the use of ACV s, we still hear the objection, "It's not economical." But since when has Canada instituted and maintained transport routes only when it was economical to do so? John Jenness of the Department of Northern Affairs & National Resources told the Canadian Association of Geographers: "In a sense, the situation there (the north) today is much the same as it was farther south a century ago, when rail builders possessed the daring and foresight to lead settlement into the Prairie Provinces; for the north is presenting us with the same risk of high costs and obscure markets that faced us in those days on the Prairies."

There is solid justification for the practice of the Canadian Government subsidizing transport routes essential to Canada's welfare. No other country in the world has so small a population (20 million) scattered over so wide an area. One estimate is that Canada could usefully employ 25 to 30 ACVs within the next 10 years.

The trials at Tuktoyaktuk (called "Tuk Tuk" from here on) took place from April 22 to May 30, 1966, as the winter ice cover was breaking up. They were mainly at Tuk Tuk and vicinity, over the fast ice in Kugmallit Bay (at the southern coast of the Arctic Ocean or Beaufort Sea), and 450 to 500 miles along the Mackenzie River from near its gulf to the village of Norman Wells. Temperatures ranged from —24° F to 60° F.

The Canada Defense Research Board's report on the Tuk Tuk trials indicates that the ACV is at home in the Mackenzie River area. This is significant because the types of ice and snow correspond to those in much of northern Canada. The ACVs took in stride regions of flat ice with drifts of wind-packed snow; rough first-year ice, and pressure ridges. The steepest slope cleared, in Tuk Tuk harbor, was 17 feet high and was negotiated successfully at an approach speed of 25 knots.

NOV 6 1967 THE BOREAL INSTITUTE LIBRARY



First Use of ACVs Expected In The South

IT MAY well be that the first ACV to be purchased or leased by the Canadian Government will be employed in southern Canada. Some uses there could pay for themselves today.

The technical capabilities of the craft were proved out by actual trials at Trenton, Ont., which began on Oct. 24, 1966, and continued for a month. A SK-5 chartered from Bell Aerosystems Canada was successfully put through a number of mothership, search and rescue, towing, and high seas operations by the Coast Guard wing of the Department of Transport. Five-foot seas were encountered, with winds blowing from 20 to 30 knots. During simulated rescue operations, basket litters were transferred from rafts to the ACV. During some of the tests, an 11-foot dinghy and a large turbine fire pump were lashed to racks on each side of the ACV, but they had little effect on operating performance.

Passenger runs offer the largest potential application for ACVs in southern Canada:

In the Maritime Provinces — Across the Bay of Fundy, between St. John, N. B., and Digby, N. S. and also between Prince Edward Island and the mainland.

Across Lake Erie—St. Thomas to Cleveland; Pelee Island to Canadian mainland.

Across Lake Ontario—Toronto to St. Catharines; Toronto to Rochester; Kingston to the U. S. shore.

On the Ottawa River — Montreal to Ottawa. (An ACV can easily overcome the rapids in the Ottawa River, just as it did the Lachine Rapids at Montreal.)

'Snow Lanes' Must Be Mapped . . .

Drawing upon the experience at Tuk Tuk, it can be assumed that the ACV would operate successfully over large areas of the north. Undoubtedly there are physical obstacles. A few of the off-shore ice pressure ridges might prove too massive for today's ACVs. The wrecker's ball might be the only way through. One source suggests maintaining a right-of-way onto the beach, just as airport runways are plowed after a snowstorm. In the long run, however, many of these obstacles can be overcome by simply building bigger machines with longer skirts. Bell Aerosystems, for example, says it will soon be making ACVs with skirts 8 feet high, and that in a few years it will be turning out ACVs 150 feet long, supported by skirts 10 to 12 feet high. The longer skirts, combined with improved radar and well-mapped ACV "snow lanes" in the more treacherous areas, will widen the portions of the north which future ACVs will be able to traverse.

Canada's far north transit routes are hardly impressive. Canada's only Arctic river of consequence, the Mackenzie, is also the only one in the north that is navigable and connects with the rail transportation system of the Canadian interior. That point is being driven home with increased force these days as activity booms in the Pine Point mines near the southern shore of Great Slave Lake. Last year they shipped 900,000 tons of ore.

The Great Slave Lake Railway, built two years ago, now makes it possible to move supplies by rail northward from the Canadian Provinces to the southern shore of Great Slave Lake. Here freight is transferred to barges for the run down the Mackenzie River, which has the lake as its source, and into the Arctic interior. But this barge trans-shipment is restricted to the summer months, and even then it is extremely inefficient, cumbersome and slow.

ACVs could make deliveries the year round, adding the dimension of speed to Mackenzie River transport. Ideally, cargo ACVs would run the full length of the Mackenzie. Making intermediate stops enroute, they would come up onto land and off-load cargo directly into settlement warehouses.

The Coast Guard — the seagoing fleet operated by the Marine Services of the Department of Transport — delivers annually about 100,000 tons of supplies to eastern Arctic ports for distribution to some 75 settlements and outposts. It must rely on icebreakers, which are extremely inefficient as cargo carriers. Because of the ice, they get up to the Arctic late — in July and August — and they must leave early, by the end of September or early October. Much of the tonnage has to be delivered to open beaches, where the ACV would be in its element.

One expert estimates an immediate two to three-fold increase in efficiency if the Coast Guard ships moved north with ACVs as tenders. They could leave southern ports earlier—May or June—and stay perhaps till November. Life at such East Arctic ports as Clyde, Pangnirtung and Pond Inlet would be a lot easier.

After finishing its supplies-beaching operation, an ACV could carry out ice and navigational aids reconnaissance. When through patrolling, the ACV would return to its mother ship and all would proceed to the next port of call.

C-130 aircraft, Otters, and Beavers, as well as VTOL and STOL aircraft, can all play very useful roles in the north. Yet they have their limitations. A C-130 can land at Resolute, for example, only during mid-winter. The ice is too thin to support such a big aircraft—or even Beavers and Otters—during spring and fall. What's more, landing conditions are often hazardous. With ACVs, supply operations could continue unhindered.

Limited trucking operations exist

In British Columbia—from Vancouver to Victoria and to Seattle.

Patrolling is another good possibility. The Department of Transport is beginning a traffic control patrol between Montreal and Les Escoumains, which is about 40 miles down the St. Lawrence River. The Department must also maintain a pollution patrol. ACVs, because of their versatility, could do both and might also transport river pilots between ship and shore. During the winter, ACVs could conduct ice patrols in the Montreal harbor and in the shipping lanes leading from Montreal, especially those to Lake St. Peter.

Larger ACVs may be just the ticket for transporting crews and material to hydro-electric installations in northern Manitoba, in northern Quebec as at Manicouagan, and along the Aux Outardes River.

Production of ACVs capable of such service is expected to be under way soon in Bell Aerosystems' plant near Niagara Falls, where tools and an assembly line are being set up. Until now, virtually all of the testing and experimentation in Canada has been with the British Hovercraft's SR-N5 or its Bell Aerosystems equivalent, the SK-5. The new production facilities of Bell Aerosystems are scheduled to turn out a commercial model of the SK-5; a larger SK-6, capable of carrying 38 passengers, and the SK-9, a 25-ton craft which can transport 91 persons or 12 tons of payload.

With such a variety of models, appropriate craft will be available for most transportation needs envisioned for Canada in the near future. ■

Irwin Wolfe, 29, has gained close familiarity with Canada's prospects as an associate editor of "Canadian Transportation," published by Southam Business Publications. An article on improving transportation in Northern Canada, which he wrote in December 1965, brought comment from Northern Affairs Minister Arthur Laing and Prime Minister Lester B. Pearson. He holds a commercial pilot's license and has traveled extensively throughout his native country. Born in Montreal, he speaks English and French. Mr. Wolfe has also been an associate editor of Business Management Magazine. He resides in the New York City area now, but he has retained his Canadian citizenship and frequently returns to the area on which he has become an expert.

National Film Board of Canada Photo

in the northern territories. Trucks are employed, for instance, in the Yukon, in the Great Slave area, and to link the southern transportation systems with the Mackenzie River area.

The outlook for more roads in the north is not good. By and large, building conventional roads is prohibitively expensive. There has been a meager attempt to lay snow roads in the area between the Mackenzie River and Great Bear Lake. But they are used for the most part by soil exploration crews, travelling in tracked vehicles; the roads are not good enough for wheeled vehicles. Using ACVs could obviate most, if not all, of the difficulties.

There are many more potential uses for ACVs:

Law enforcement. The Royal Canadian Mounted Police today patrol the vast area by dog sleds, snowshoes, snowmobiles, aircraft of many types; ACVs would be extremely useful.

Medical. While on patrol, law officers equipped with ACVs would also function as police ambulance teams. As matters now stand, there are periods when medical help simply cannot get into settlements. Even when medical teams are parachuted into northern outposts, they must often remain there during thaw and early freeze because the ice cannot support the landing weight of aircraft.

Mail delivery. Service now is abysmally poor; there is virtually no scheduled transportation of any kind between Canada's east and west Arctic regions. The ACV can serve effectively as a sort of jitney bus to feeder airlines while doubling as an alternate mail distributor.

Education. Canada's indigenous northern citizens—to a large extent Indian and Eskimo—can be taught to farm, serve as mechanics, and the like. ACVs could bring them to training centers. Likewise, their children could be sent to schools that would be well built, well equipped, and centrally located. Admittedly, students would have to live in for the duration of the term, but with ACVs it would be a lot simpler for northern authorities to see to it that children catch up with their nomadic parents.

Exploration. ACVs could put most northern exploration work on a 12-months-a-year basis. Mineral and scientific exploration work now must cease during break-up and freeze-up, when snow gets soft on land and no vehicles can move nor can any planes land. Field parties, for the most part, go idle, at great expense to the companies or government departments that send them in.

Efficient use could be made of ACVs in scientific forays involving hydrography (charting the ocean bottom), magnetic surveys (for keeping tabs on the magnetic storms causing radio blackouts all over the world), gravity surveys and seismological surveys. Typically, such teams must cover wide areas quickly, with only short stays in any location.

For some time now, thought has been given to using ACVs for surveys of the Polar Continental Shelf. The Department of Energy, Mines & Resources has about 40 men, almost all scientists, stationed at various bases such as Mould Bay, Isaacson, Alert and Resolute. To supply and service them, the Government operates five helicopters and a few Otter and Beechcraft aircraft.

The report on the Tuk Tuk trials points out that the ACV "is ideally suited to many scientific roles. It could be used to ferry small parties and equipment between a central base and field locations up to about 50 nautical miles away. It could be used as a mobile laboratory complete with appropriate instruments installed in the craft. As such, the craft could travel across a variety of terrain types and stop as required to sample data. It would not be necessary to shut down the engine unless the craft were to be stopped for periods longer than, say, 15 minutes. The space available in, and payload of, the craft would allow supplies for a small number of people for several days to be carried, as well as a reasonable amount of scientific equipment."

Better transportation, for any of a dozen purposes, is one of the area's most pressing needs. ACVs can abolish or overcome much of the isolation now an inescapable part of living "up North." The revolutionary new craft can bring reliable mail and medical service, serve as bus routes feeding air stops, and make possible schools that are better equipped and easier to reach. With these improvements, who knows, more people may actually move northward. Even if they don't, life could be a lot easier for those 50,000 or so Canadians who now make the northlands their home. ■

POLAR
PAM
4646

POLARPAM

Reprinted from Rendezvous Magazine • Published by Textron's Bell Aerosystems

Pam. 629.1.039. B.H.C. L.S.

Reprinted from

Air-Cushion Vehicles

JANUARY 1967

Supplement of FLIGHT International

THE BOREAL INSTITUTE
LIBRARY
DEC 13 1967

POLAR
PAM
4646

POLARPAM

Cover picture: *Viet Cong guerillas are rounded up and their sampans destroyed by American and South Vietnamese special forces operating aboard the US Navy's three British-built hovercraft evaluated in combat. The action took place recently in the Plain of Reeds, near the city of Moc Hoa. The small picture above our masthead shows one of the heavily armed SK-5s at speed across a relatively dry part of the Plain. An account of this action, and other Vietnam ACV operations, begins opposite*

BRITISH HOVERCRAFT—WORLD LEADERS IN THE HOVER TRANSPORT REVOLUTION

BHC

YEOVIL ENGLAND

british hovercraft corporation limited

1966
WESTLAND AIRCRAFT LIMITED
SAUNDERS-ROE DIVISION

Lt K. Luenser, OC of the USN ACV unit (second from left) during a short break from operations in the Plain of Reeds at the end of November. With him are three craft commanders, Lts (jg) W. C. McCollum, R. E. Adair and K. C. Kumler. Lt Kumler was also unit maintenance officer throughout the entire Vietnam evaluation

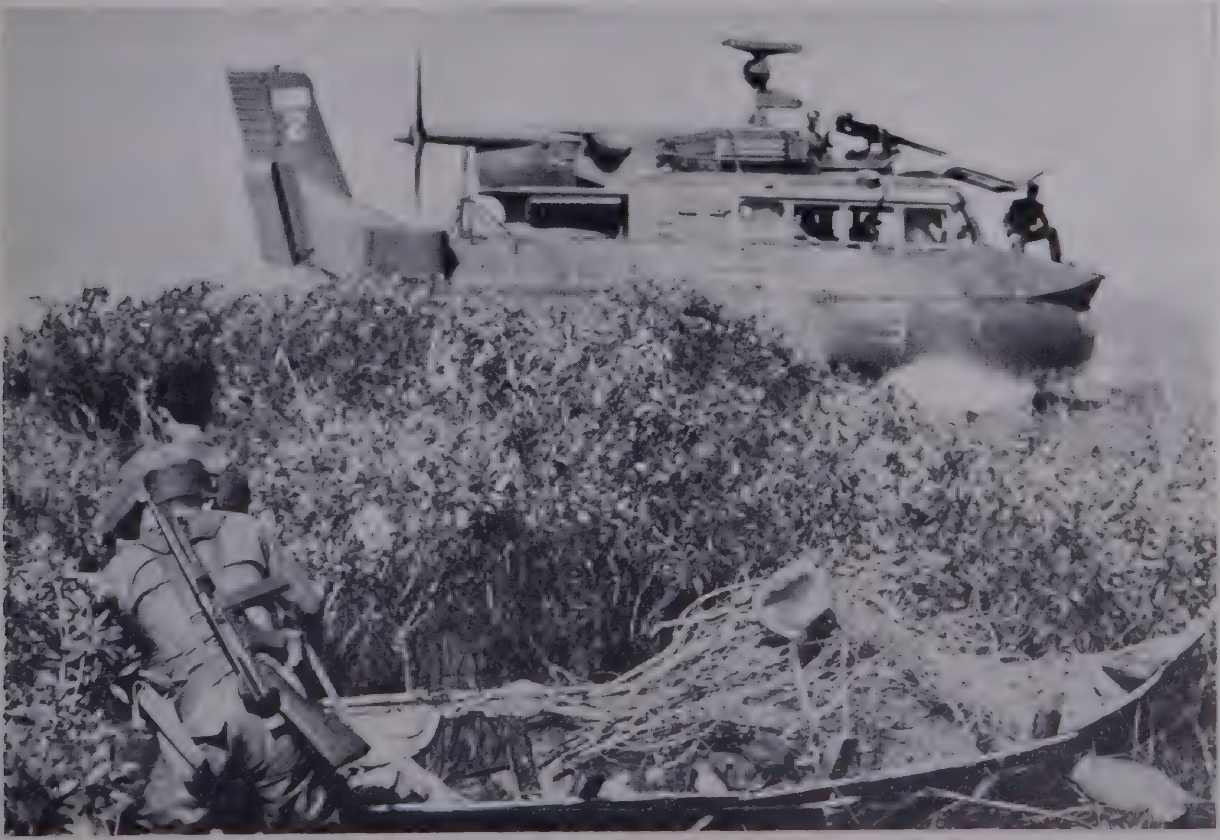
IN ACTION IN ANGER

ACV Evaluation in Vietnam Reviewed

By ROBERT R. RODWELL

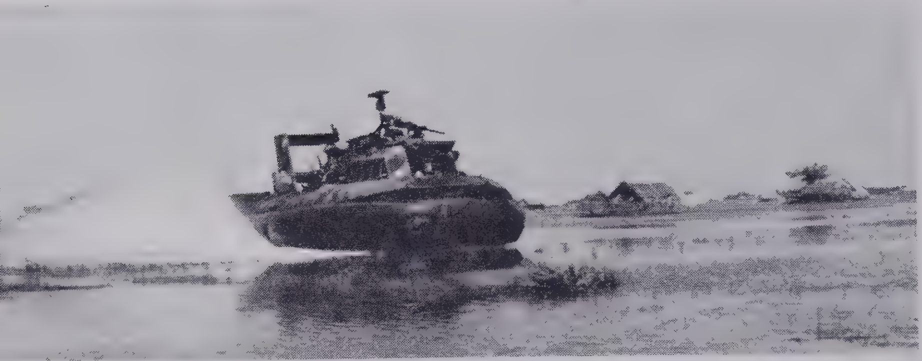
THE UNITED STATES NAVY'S three Bell SK-5s, sent last year for a combat evaluation in Vietnam, were instrumental in inflicting a heavy defeat in late November and early December upon Viet Cong guerillas who had earlier played havoc with US and Vietnamese Special Forces in an extensive swampland area known as the Plain of Reeds, near the Cambodian frontier due west from Saigon. This operation, in which use of the ACVs

This concealed sampan is typical of the Viet Cong boats found and flushed out from cover in the Plain of Reeds action. The Vietnamese soldiers are just stumbling upon a second sampan. The SK-5 behind mounts two topside 0.50-cal machine guns and two side-mounted 7.62mm machine guns. Fixed, rearward-firing 7.62s were also installed in the rear panniers of one craft

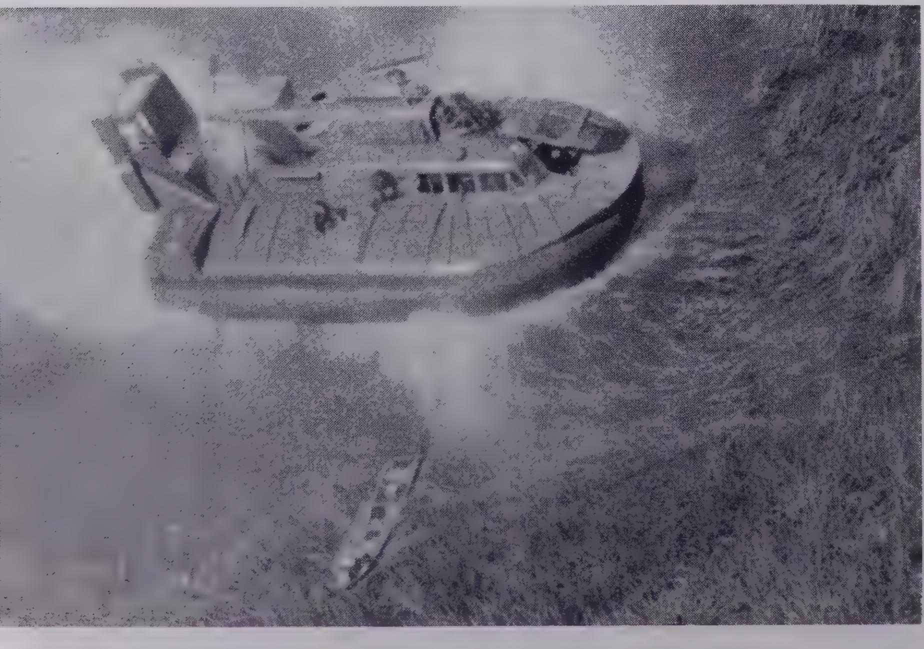


Carriage by SK-5 gave the Special Forces and civilian irregulars great mobility in an area of waist-high water

IN ACTION IN ANGER



(Above), an open area of the flooded Plain of Reeds, much of which is covered by high growth providing excellent cover for VC guerillas, until the joint ACV/helicopter operation deprived them of it. (Below), an SK-5 comes up to a VC sampan, the occupant of which was found hiding beneath the water and breathing through a reed



enabled Special Forces to sweep in a few days an area which takes three months to cover by other means, was the most successful phase of the entire Vietnam evaluation and is credited with having heightened considerably the US Army's interest in ACV potentialities.

Last month *Air-Cushion Vehicles* visited the ACV unit, PACV Div 107, Boat Sqn 1, at its base at Cat Lo, on the mouth of the Saigon River, which it shared with USN and Vietnamese Navy coastal and river patrol forces. Unfortunately, our visit came too late to see the craft in action, for the evaluation was concluded shortly after the Plain of Reeds operation and the SK-5s were being prepared for loading the next day aboard the LSD which was to return them to the United States. They were shipped out on December 16 for San Diego, Calif, and ultimately Buffalo, NY, where, one by one, they are to be completely refurbished by Bell. The personnel of the unit, six officers and 28 men, were also preparing to depart—some by sea with the three craft, the rest by air, for their parent base at San Diego. A lengthy conversation, however, with the OC, Lt K. Luenser, and his maintenance officer, Lt (jg) K. Kumler, who was also a craft commander, proved to be an excellent briefing on the unit's experience in Vietnam.

The unit arrived in Vietnam on May 1 last year aboard an LSD, and began operations from Cat Lo on May 3, immediately a PSP ramp and hardstanding had been completed. Initially the unit operated as an integral part of Operation Market Time, the ceaseless USN/Vietnamese coastal screening which largely prevents supplies being run by sea to Viet Cong forces. In Market Time the SK-5s operated in conjunction with 88ft US Coast Guard cutters and 50ft USN "Swift boat" coastal patrol craft, as well as operating independently, and they came under fire from the shore.

Subsequently the ACVs were assigned to Operation Gamewarden, the continual surveillance of the river shipping channels in the many distributaries of the Mekong and Saigon Rivers. These channels are of particular importance in the logistic supply of the allied forces in Vietnam, since the lack of good ports and deep-water berths in South Vietnam compels many freighters to be unloaded in coastal anchorages and their freights moved inland by smaller craft along the river channels. For the patrol of the river channels proper the USN has recently put into service a large fleet of river patrol craft—PCRs—31ft long hard-chine boats propelled by diesel-driven waterjets,

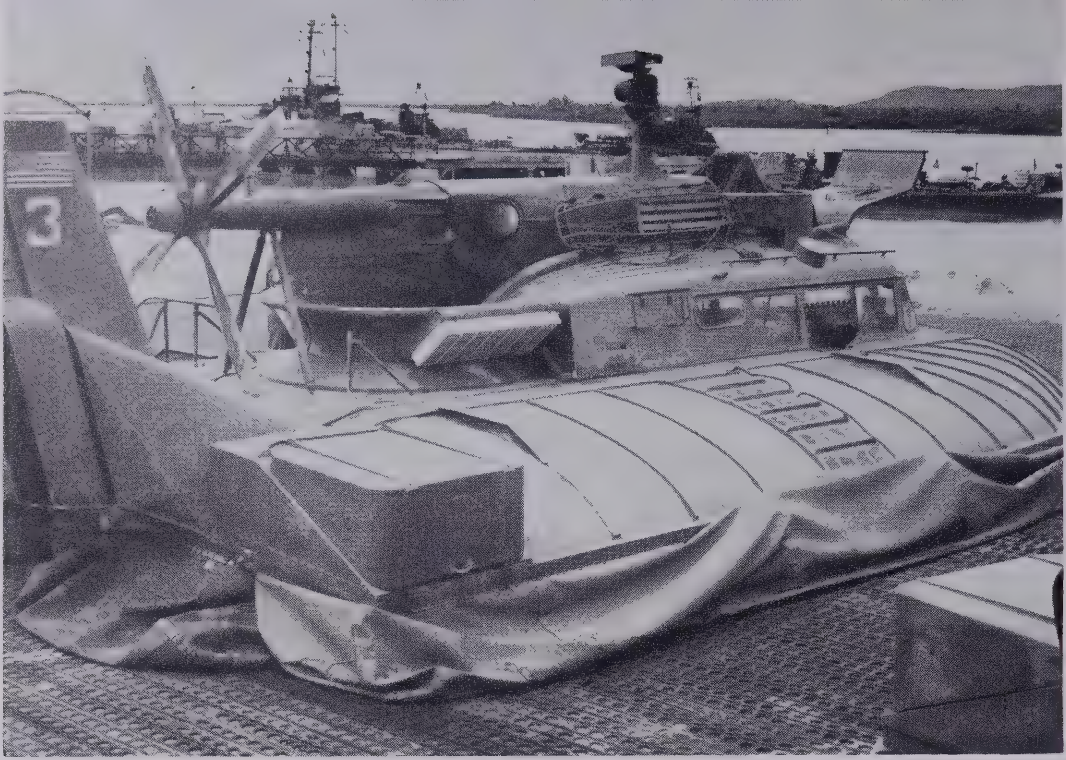
Among the troops carried aboard the SK-5s in the Plain of Reeds were flamboyant members of the Vietnamese Civilian Irregular Defence Groups, left. Right, Bell UH-1B Iroquois "gunships" escort an SK-5, carrying troops on its side-decks, at the end of a day's sweep

armed with 0.50-cal machine guns fore and aft and possessing negligible draught at speed. It was with PCRs that the SK-5s worked in the first Gamewarden phase; the boats patrolling the higher reaches and the ACVs patrolling the shallow estuaries. For this phase they operated from an LSD dock ship stationed offshore and on numerous occasions drew fire from river banks. Several estuaries were patrolled—notably the Bassac and Co Chien mouths of the Mekong.

Following a period of this work the craft were stood down at Cat Lo for some weeks for various modifications. The evaluation had begun with only one gun—a 0.50-cal machine gun—fitted to each craft, on a topside swivelling mount. Extra armament, it was felt, would be valuable, and thus the topside mount was doubled for two 0.50s, and two 7.62mm machine guns were also mounted, one on either side, firing from the cabin windows and carried upon standard helicopter-type mounts. For even greater firepower one craft was fitted with fixed aft-firing 7.62s mounted in the rear freight panniers. The weight, of course, crept upward; the 18,000lb maximum gross became purely nominal and the SK-5s operated at over 20,000lb frequently.

Following the modification phase the SK-5s were returned to coastal patrol—Operation Market Time—for a further month and then resumed in the Gamewarden role—this time patrolling the rivers, using shore refuelling dumps, rather than the estuaries and refuelling from an LSD. The Soi

VC captives are placed aboard an SK-5 for evacuation and hand-over to the South Vietnamese authorities



One of the three SK-5s on the hardstanding at Cat Lo, where a base was shared with USN, USCG and SVN coastal and river patrol forces. Signs of gunfire hits can be seen on the ACV "Air-Cushion Vehicles" photograph

N ACTION IN ANGER . . .

Rap and Lung Tau rivers were patrolled for some weeks in this manner. Patrols were then mounted on the My Tho River, northernmost of the Mekong distributaries and involving a 23-mile transit across the bay from Cat Lo. This transit was made several times, the craft refuelling at the city of My Tho for a patrol period and then returning to Cat Lo.

Virtually all Gamewarden operations were by night. Lt Luenser, the OC, and his maintenance officer were both very complimentary about the performance of the Decca 202 radars installed in the SK-5s (and now to be found aboard numerous USN patrol craft in Vietnam), praising its worth both as a tactical aid and as a navigational hazard-spotter. In the Vietnam operations the main hazards (other than the enemy) proved to be fish traps, varying from flimsy affairs strung between stout withies of about 1in diameter, to beefy permanent structures comprising telegraph-type poles with heavy cables strung between them. In general, however, it proved possible to identify, and avoid, these by radar.

It was late in the planned evaluation period that the ACVs really came into their own and radically transformed the tactical situation in one particular area of South Vietnam. On November 14 US and Vietnamese Special Forces looking for a suspected Viet Cong platoon in the Plain of Reeds, near the Cambodian frontier and the city of Moc Hoa, ran into a whole company and were heavily mauled, losing 15 men and one assault boat. On November 21 an extensive sweep of the Plain of Reeds began, using the ACVs. The wet season was ending and the water level falling, hampering the assault boats and airscrew-driven swamp buggies that were being employed in the area. All three SK-5s were made available for the operation—the normal state during the earlier phases of the evaluation being two craft operational and one under maintenance. Together they made the 150-mile transit from Cat Lo, up the My Tho and Mekong Rivers to the extensive marshy region, where they operated entirely without maintenance for five days, before making the one-day transit back to Cat Lo for maintenance and then repeating the performance for a second week.

The Plain of Reeds operation involved the ACVs with the assault and swamp boats already mentioned and both armed and unarmed Iroquois helicopters—in the strange argot of the Vietnam war, "gunships" and "slicks" (but both UH-1B "Hueys") respectively. The troops employed comprised US and Vietnamese Special Forces and Vietnamese civilian irregulars, who were flown in by US Army and USN helicopters and who, in the Plain itself, were often carried as outriding passengers on the SK-5 sidedecks. Thirty-two sampans were damaged or destroyed, prisoners and rice stores captured and numerous huts burned on this first day.

On November 22 helicopters drew fire from an armada of about 25 sampans otherwise concealed in high reeds. This fleet was engaged by the ACVs and the air-boats when it tried to flee, troops were air-lifted in, and in the ensuing fighting no fewer than 56 Viet Cong were killed, with only one "friendly" being wounded. A large amount of VC supplies was destroyed—mainly by the simple expedient of running the ACVs over the low sampans, thereby capsizing them and tipping their contents into the water. Attempting to avoid the ACVs, some Viet Cong jumped overboard and tried to conceal themselves beneath the surface, breathing through the hollow stems of reeds. Shelters were again burned on this day and the big Johnson outboard which had been lost with the assault boat the week before was recaptured, together with VC combat reports which indicated that this was the same outfit which had previously blown up three bridges. On November 25 the ACVs again saw action, 16 miles south of Moc Hoa, when they were credited with the killing of ten VCs and the capture of a further six. The superiority of the ACVs over the assault boats and swamp boats became more marked as time passed and the water

In the Plain of Reeds a number of VC shelters were burned. Here a craft lifts up to depart the scene after firing a hut

level continued to fall. By the end of the operation these boats had far less mobility than at the start.

The Plain of Reeds action proved the SK-5s to be rugged and little difficulty was encountered in traversing areas of high reeds which were virtually impenetrable by any other means. The craft were quite happy knocking down dense reeds of 2in diameter, without incurring significant damage. The most severe damage during the entire evaluation resulted from a collision between an SK-5 and a PCR during the My Tho Gamewarden phase, when the port bow was extensively damaged. Despite this the craft was able to make its own way back to Cat Lo, with an open-sea transit, where it was repaired by a USAF working party—the predominantly marine specialisations of the unit's own maintenance personnel leaving it ill-equipped to handle light alloy structural repairs.

For the first time in the writer's experience, skirt wear was *not* cited as the main maintenance problem of ACVs by the engineer in charge. Lt Kumler reported that skirt wear was quite satisfactory, except for the disintegration of one keel member after 180hr, which proved to be a BHC quality control shortcoming in that it was defective and should not have passed inspection at Cowes. There was more wear on the rear bags than on other skirt segments, and some chains and hinges were broken, but the maintenance officer did not consider these failures to be more than fair wear and tear.

Reliability of the GE T58-LM-100 engines was exceptionally good and there was no instance of an engine failing while a craft was under way. Engines were run to over 300hr and the unit saw the entire evaluation through with three spare units, those removed from the craft being returned to the US for maintenance.

Higher utilisation could have been achieved, it was felt, if the craft had been wholly Americanised and if there had been no need of reliance on a very long supply line from Cowes for certain purely British spares. Since any further US military SK-5s, if more of this type are eventually acquired, will come from Bell's newly set up production line, they will be wholly Americanised and the spares problem will be correspondingly reduced.

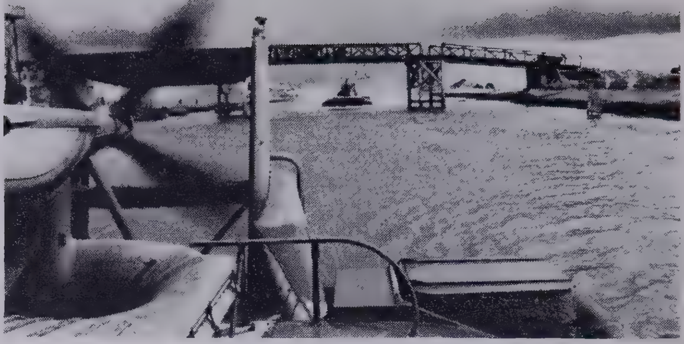
The unit suggested two design changes in the light of its experience in Vietnam. At present the SR.N5, and the American-engined SK-5s reworked by Bell, have a common oil system to all services. One engine had to be replaced when a hydraulic pump serving the skirt-lift system disintegrated and contaminated the entire oil system, and the unit's proposals are to separate the skirt lift and engine oil systems to prevent such a recurrence. A necessary modification made at Cat Lo was to replace the balsa-and-aluminium floor panels with floors of heavy gauge aluminium after the original panels became impregnated with salt water and then delaminated.

Vietnamese civilian irregulars are embarked here at a US Army Special Forces camp for action near Moc Hoa. Note the position of the US emblem on the SK-5

During operations over mudflats in the mouth of the My Tho River a phenomenon occurred identical to that experienced in last May's evaluation of a British IHTU SR.N5 in the Mackenzie River Delta, in Northern Canada. The SK-5 was being operated at low cushion pressures in an endeavour to reduce the mud spray which was otherwise generated. In this régime the rear bags filled rapidly but asymmetrically with several tons of mud and the craft began describing circles. It was quite uncontrollable until the bags were slit open and the mud removed. In the Canadian evaluation, exactly the same thing happened with snow.

Beyond the installation of gun-mounting and some lightweight plastic armour protection, few modifications were made by Bell to the SK-5s before their shipment to Vietnam. One of these was the installation of a combat switch which overrides the engine's automatic shut-down safety features. In the event of a malfunc-

IN ACTION IN ANGER . . .



Between the base at Cat Lo and the swamps around Moc Hoa, where the main action was fought, was a 150-mile sea and river transit. The ACVs are seen here negotiating a bridge at An Long on their return to Cat Lo after five days' continuous operations without maintenance. After a day's maintenance at base they returned to the Plain for a second five-day period

tion occurring when the switch is set to "combat," the driver is given a warning light but that is all.

Another USN-specified modification was the installation of a small four-stroke APU. This was installed, together with the batteries, under a high bench across the rear bulkhead of the cabin. In service the crews often regretted the loss of cabin space which this entailed. Normal crew make-up in Vietnam was one officer and four enlisted men with a further officer in tactical charge of the craft, or of a pair. It was quite early decided that tactical command was not best exercised by an officer preoccupied with driving the vehicle, and excessive responsibility was being placed in "hot" situations upon the enlisted man behind the radar set. It seems likely that future USN practice may follow that evolved by the evaluation unit in Vietnam under which the officer in command is behind the radar set in any fraught situation, with a subordinate officer or senior rating driving the vehicle. The USN took no account of those who consider ACV driving a job for aviators when training crews to man its pioneering hovercraft unit, for all the unit's original drivers were non-aviating mariners—deck officers, an engineer in Lt Kumler's case, and, in the case of the non-commissioned drivers, bosun's mates. Subsequently one driver with a flying background was posted in, but the USN experience in Vietnam further undermines the aviators' presumptuous but now largely discredited claim to a particular ACV expertise.

In all, 1,063hr of operation were completed by the three craft in Vietnam—385hr by 004 (which had seen service before sale to the USN as Bell's demonstrator and now has more than 850hr); 272 by 015; and 406 by 017—the production numbers indicating their place off the BHC line at Cowes. When we saw them on the ramp at Cat Lo last month they looked, frankly, very well used indeed and likely to benefit from Bell's rebuilding efforts. They had the worn look of seasoned fighters—battered, bent, but unbowed. They had been hit on several occasions by enemy fire, but never cripplingly and in retribution they had dished out more than they received. They will be rebuilt in turn at Buffalo, for one will be at San Diego at all times to train replacement crews. No announcement has been made about the USN's further plans but the unit has returned as one and remains in being at San Diego.

It was in the predominantly Army context of the Plain of Reeds that the USN unit made its biggest impact, and saw its biggest success in Vietnam. In the naval roles of coastal and river patrol the 5hr endurance of the SK-5s at a high power setting was a limiting factor and their speed advantage was rarely required. But ACV seaworthiness and controllability were displayed in a live SAR operation when one craft rescued several people standing neck-high in water on a sandbank after a junk capsized in 40kt winds, and it was then driven into an LST with 6-8ft waves running and a 28kt cross-wind.

With the thoroughness which invariably accompanies any American evaluation of this kind, the fullest data was assembled in Vietnam and this is by now, no doubt, giving body to detailed reports being studied avidly in the Pentagon and elsewhere. Nearer the scene of learning, at US Military Assistance Command HQ in Saigon, it's a fair bet that people are already bemoaning the departure of the ACVs. With US Army interest now very much aroused, they are unlikely to have made their last appearance in Vietnam. The next move of the US Services in the realm of ACVs is rumoured to be imminent and it is likely to be big.

Having packed the hours in—1,063 on active duty in Vietnam—the three SK-5s looked battered and war weary on December 14 as they awaited loading aboard the dockship which departed on December 16 for the United States, where they will be refurbished by Bell

"Air-Cushion Vehicles" Photograph

Printed in Great Britain by Gibbs and Bamforth, St. Albans, Herts. RP 2805

9.7

B.H.C.

Pam. 629.1.039

Reprinted from
"Air-Cushion Vehicles" Supplement to
FLIGHT *23 February 1967*
International

SINGAPORE NIGHT OUT

By Lt C. STAFFORD, RN

British Hovercraft Corporation Limited
Yeovil · England

POLAR
PAM
4646

THE BOREAL INSTITUTE
LIBRARY

DEC 13 1967

POLARPAM

THE MILITARY SCENE—2

SINGAPORE NIGHT OUT

by Lt C. STAFFORD, RN

Reportage of the two evaluations of ACV in combat zones held so far, in Malaysia and South Vietnam (see our April 1965 and January 1967 issues respectively) has dealt in the main with aspects other than that of coastal screening and the interception of small craft. The omission is now covered by this exclusive report, by the only naval officer in the joint-services Hovercraft Unit (Far East), of the coastal-screening phase which occurred toward the end of the British Services' evaluation in the Far East.

SINGAPORE IS AN ISLAND more or less the shape of the Isle of Wight, so it was particularly fitting that it should be the scene of the first operational hovercraft night trials.

Shape, however, is the only resemblance and in addition to obvious distinctive features, at the time Singapore and Malaysia were subjected to confrontation by Indonesia. Singapore Island, at the southern tip of the Malay Peninsula, is separated from Indonesian territories by the Singapore Strait, a narrow stretch of water varying in width from 1½ to nine miles and about 30 miles in length. The area abounds in numerous small islets and shoals and is also the main shipping lane between the Indian Ocean and the China Sea. The problem facing Malaysia, Singapore and their allies was to effect a naval blockade across the Straits to prevent infiltration from Indonesia, but at the same time not to impede lawful shipping. Very much a "forgotten war" was waged in the Singapore Strait, but the number of decorations awarded for bravery serve to illustrate the very real threat of infiltration throughout the period of confrontation.

Constant surveillance of the area was maintained by patrolling ships and shore-based radar but the task was hindered by a very large number of spurious radar contacts such as floating mangrove roots and old boxes, all of which had to be investigated. Would-be infiltrators using small sampans with very powerful motors would attempt to drift across the border in the guise of a floating object but would use high speed to effect a getaway if spotted. With a top speed of 40-50kt and a draught of only a few inches these craft were at a considerable advantage over the relatively slow, deep-draught patrol vessels.

However, by using large numbers of ships the blockade was very effective in the Eastern Straits but was much more difficult to implement amongst the islands in the south west due to shallow water, coral reefs and the close proximity of Indonesian territorial waters.

Preparation for Naval Trials

Here was an obvious task for a fast craft able to negotiate shallow water but before the SR.N5 could be considered for the job an all-weather—that is, night—capability was required. Night operations in hovercraft are always overshadowed by a misconception that such operations are difficult and hazardous and that all hovercraft navigational systems must necessarily be complicated to overcome the problems. For ocean-going hovercraft, navigational systems are still under development but for a craft within radar range of the coast the "sailors" were optimistic that a simple navigational solution could be found.

Before leaving UK, the two Far East SR.N5s had been fitted with minimal navigation equipment comprising a gyro compass, Decca 202 stabilised radar, Marconi Doppler speed meter and a conventional aircraft rate-of-turn instrument. In addition, under development for the 202 at Decca, was a simple manual chart-matching device, with plotting facilities, which produced instant craft position by aligning a picture of the chart to the picture on the radar screen. For operations over beaches where marine radar gives no picture, the craft were fitted with "headlights" which were a proprietary brand of motor-car fog lamp selected for good cut-off properties to prevent dazzle from spray. (This idea came to the author whilst reading an article entitled "The Legal Aspects of Hovercraft," in *Air-Cushion Vehicles,* which suggested they should obey the Road Traffic Act.) Preliminary Trials were made in February 1965 to assess the magnitude of the problem of operating in this naval role and over the next six months, during the Army trials in Borneo, drills and procedures were evolved to enable the SR.N5 to work as an integrated unit of the defence force.

Navigation at Night

There were three basic navigational problems to be solved: determination of position, track and speed; collision avoidance; and target interception. The overall solution seemed to be a compromise between sea and air navigational techniques. In addition, only one internal communication channel was available in the SR.N5 and the final solution would have to be simple enough to be interposed on this single channel, which also carried all external command traffic. Gradually an information flow diagram was built up and this diagram, together with an explanation, appears on page 3.

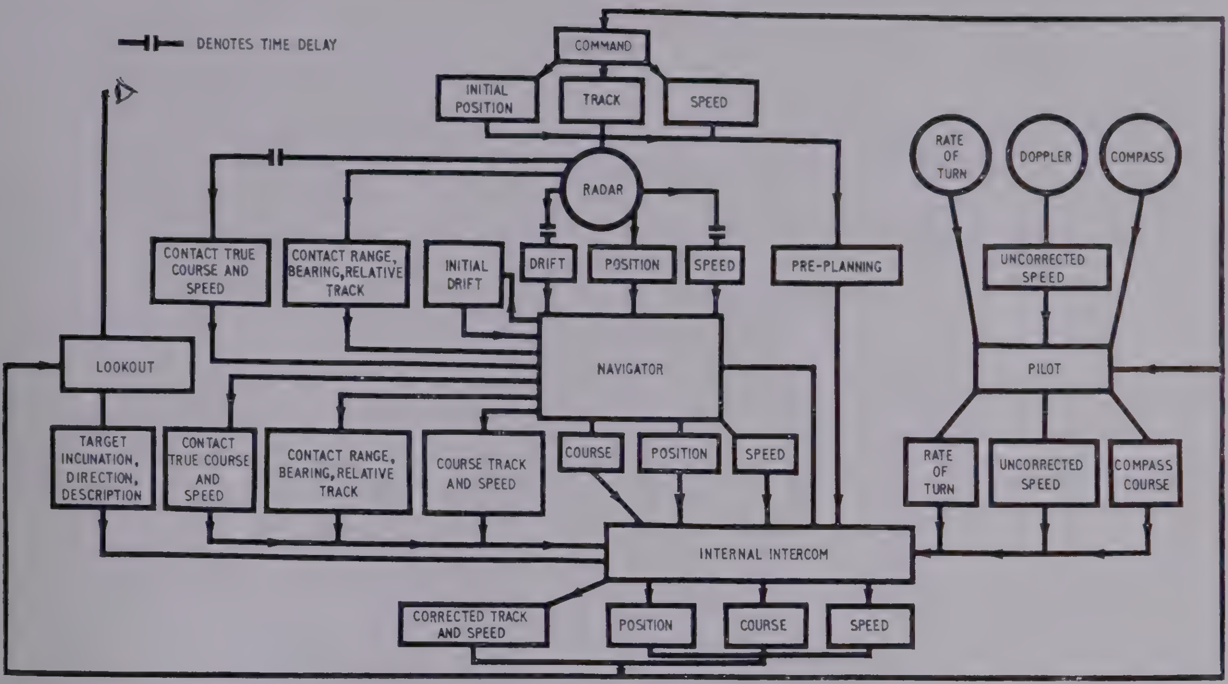
Position, Track and Speed

Position was determined direct from the optical navigational attachment (ONA), the chart-matching device on the radar. Position reporting by this method was so successful that the SR.N5 could normally answer a call for a ship's grid position before the ship itself.

Initial course to steer to maintain desired track was determined by using a "navigator's eye" assessment of drift; the angle between course to steer and track made good. No Dalton-type computer was available but the experienced navigator was able to make a very accurate assessment of initial drift. Once underway accurate drift could be obtained from the ONA by using a simple plotting technique, which also produced on the ONA chart a permanent record of craft movement, i.e., actual track.

Initial speed was taken from the Doppler but as the instrument did not correct for yaw and pitch, accurate speed of advance could only be obtained from the radar. The speed measuring device was normally ±5 per cent accurate which was sufficient for instantaneous speed requirements. An ASI was also fitted but could never be relied on to give any sort of accurate reading as the pitot head was usually blocked with salt.

The SR.N5 is too small to be fitted with true-motion radar and stationary objects race across the screen in the opposite direction of the craft. However, once trained, navigators developed the "feel" of this picture and could make their normal interpretations, but there still remained the solution to the relative velocity problem created by a moving object such



Night navigation information flow: the commander (may be the captain of the craft or, say, the Squadron commander), feeds the initial track and speed to the driver, navigator and look-out by means of the intercom. Any sortie pre-planning is also fed in at this stage. The navigator estimates the initial drift and passes a course and speed to the driver, plus a briefing on the track ahead. Once underway the navigator plots the position on the ONA chart and gives the driver course corrections to maintain the track—that is, obtains true drift from the radar. A contact is sighted on radar and the navigator feeds its range, bearing and relative track to the pilot and look-out. When the contact is visual the look-out feeds inclination direction and description to the navigator who quickly works out estimated true course and speed. This course and speed is confirmed from the ONA chart after a short time delay

as a ship. The ONA produced an eventual solution after a delay of several minutes, but this was too slow to begin any necessary immediate collision-avoidance action. This problem remained unsolved for some time until it was realised the initial target information report from the look-out contained the missing parameters. Concise teamwork was required between look-out, navigator and driver, but at last a practical solution had been found.

Target Interception

Details of target interception methods are not available for general release but it may be said that results were 100 per cent successful. The time to complete each target investigation was considerably reduced, thus leading to a corresponding reduction in the total number of units required to perform the task.

Before operational patrols were begun, a three-week period of intensive work-up was carried out to ensure the craft and crews attained the working standard of the Fleet. To increase the time on task a very efficient method of replenishing at sea was developed, culminating in night refuelling exercises with the replenishing ship and the hovercraft completely darkened. Navigation exercises were progressed from 30kt pre-planned "circuits and bumps" in full moonlight to 50kt unplanned passages in complete darkness through the fish traps of the narrow Johore Strait.

Communications exercises, firing practices and night landings on unprepared beaches were also included, together with ship/craft co-ordination exercises to familiarise commanding officers with the characteristics and idiosyncrasies of the craft. Finally, for two full days, practice patrols were carried out in a "quiet" area.

Serviceability remained very good throughout this period and indeed throughout the whole of the naval patrolling, in spite of the fact the craft were nearing the end of 12 months' hard work in the Far East. The running time on each patrol was 14hr ~~daily and~~ always one out of two craft was serviceable. Normally, at the end of the day's scheduled maintenance, the second craft would be on emergency stand-by. However, it was never possible to put out two craft together at night as the unit possessed only one properly modified gyro master indicator, which was swapped from craft to craft with monotonous regularity. In all fairness, a second one had been despatched by the manufacturers some months earlier but was lost in transit and they were not informed.

Forward Bases

The slipways and beaches used for these night operations can only be described as "not for the novice" and none afforded the luxury of a run-out if the approach speed was incorrect.

At HMS *Terror*, the naval base, the slipway was quite wide but the approach was fouled by a line of reserve ships and the craft had to be turned through 40° and lined up when only ten yards from the slip. At high tide there was one-and-a-half craft lengths between the water and a stout wire fence at the top.

The approach to another base was through a narrow entrance, across a "Piccadilly Circus" of scurrying small boats and up a steep slip only 38ft in width. Great skill was required to back off this slip as there was almost invariably a strong cross tide. This would catch the rear bags and sweep the stern of the craft towards a large dolphin inconveniently placed in line with the edge of the slip and 10ft out in the water. The dolphin was often a cause of embarrassment until a satisfactory technique had been evolved to suit these peculiar circumstances.

At a third base the beach was 39ft from bottom to top and quite steep. A stout wire fence at the top was a good incentive to hit the bottom at the correct speed. The approach at low tide was between a line of fish traps, over up to a mile of mud littered with small fishing boats, and then on to the beach. The radar gave no picture over the mud and the "headlights" had to be used to pick a path through the boats.

Another consisted of a small flat landing pad at the top of a very steep beach. To position the craft for a quick getaway entailed threading a passage between an L-shaped jetty and a large post, gathering speed to run up the beach, and yet hitting the bottom just fast enough to reach the landing pad and stop before crashing into the generating and communications facilities close alongside. Excessive engine power had to be avoided otherwise nearby tented accommodation would have been demolished by blast. At low water springs, there was a nasty stretch of coral exposed for 30yd in front of the beach.

Various other beaches were used from time to time including one where the landing site was a narrow stretch of shingle just large enough to take a craft sideways. To prevent damage, the craft had to be beached sideways by slewing at the last possible moment. Luckily, the site was well illuminated which simplified the landing problem on the few occasions this beach was used at night.

Craft Deployment on Patrol

In general terms the patrolling commitment could be divided into three separate tasks: Offshore patrol along the Border, inshore patrol amongst the fish traps and islands; and investigation of contacts detected in the intervening waters between these two areas of observation.

By reducing the cruising speed of the craft a continuous patrol of over five hours could be maintained without refuelling. This reduced speed was approximately three times that of conventional vessels employed on the same task and so either the area could be covered more often or the patrol distance per vessel increased. Conventional vessels were of course more heavily armed and of longer endurance, but sea state in this particular area is never outside the limits of the SR.N5 and therefore, provided adequate refuelling arrangements could be made and only lightly armed opposition was to be expected, the craft was quite adequate for the task.

In the inshore role the SR.N5 was vastly superior to conventional vessels because of its ability to skirt over shoals, mud banks and so forth and, without local knowledge of underwater obstacles, weave in and out of the islands at great speed. Small boats able to negotiate these waters cannot carry heavy armament and even the lightly armed SR.N5 could expect to be on more than equal terms with any opposition.

Craft equipment was superior to that of the normal vessels employed on this task and although the initial cost of SR.N5 is over twice that of an inshore patrol boat, the hovercraft can tackle more than twice the work. In addition, the ability to lie up silently, with the engine off, on any shoal or beach while keeping radar watch for the unsuspecting intruder, is in itself an effective deterrent to all but the most determined opposition.

The advantage of the ACV for the investigation of contacts was in its great speed. The majority of contacts would turn out to be either friendly shipping or floating debris and could be quickly identified by the SR.N5. A conventional vessel would perhaps take up to half-an-hour to arrive on the scene, only to find a false alarm. The investigation cannot be made by helicopters, while fixed-wing aircraft have no stop-and-search capability. Here, then, was a tailor-made hovercraft task.

The SR.N5 would normally lie up on a beach with the engine off and use auxiliary power to work the radar and radios. When a contact was detected the craft would start up, dash out and investigate and then return to the beach. Approximate time for getting underway was two minutes and by using this method fuel and valuable engine hours could be saved without impairing the operational efficiency of the investigation.

The Singapore trials were an insight into the potential and versatility of hovercraft in the patrolling role. However, it must be pointed out that while operations in the Singapore Strait were particularly suited to the SR.N5, there are still many problems to be investigated before ACVs can be employed in this role on a world-wide basis.

The standard of efficiency achieved and the results obtained were quite remarkable considering the difficulties which were encountered in the early stages. In addition, not only had the various authorities to be persuaded to allow such a venture in operational waters, but had an unfavourable report been forthcoming the future of the hovercraft as a military machine would have been very much in the balance. Those who took part in the trials were quite convinced that only the surface had been scratched on this new generation of war machines.

Printed in England by Gibbs & Bamforth, St. Albans, Herts. RP 3024

B.H.c. L.8

Reprinted from the
"Air-Cushion Vehicles" supplement to
FLIGHT International 20 October 1966

1

2

POLAR
PAM
4646

NEW FERRIES—TO MATCH NEW TRAINS

A POSSIBLE PRELUDE TO THE ULTIMATE CONVERSION OF BRITISH RAIL'S LARGE FERRY FLEET TO HOVERCRAFT IS DESCRIBED HERE BY ROBERT R. RODWELL

POLARPAM

Pam. 629.1.034

FUTURE MOVES by British Rail into air-cushion vehicle operations will be founded upon a solid basis of practical operating experience now being acquired by British Rail Hovercraft Ltd, the wholly BR-owned, self-contained subsidiary set up to pioneer the railways' entry into the new field of transport. Within only six months of its formal establishment and within three months of beginning services, BRH—which operates under the name "Seaspeed"—is running a highly professional, polished and efficient service across the Solent; actively promoting *ad hoc* and contract charter services; running long-term route-proving trials essential for the start of mixed-traffic cross-Channel services in 1968 and shorter term proving for an imminent extension of its Solent route; examining other promising areas of operation in Britain; and assessing possibilities of running off-season services in more temperate locales, far from winter Britain. If the British Railways Board can be criticised for losing time before deciding to make a pilot entry into ACV operation, the criticism cannot fairly be extended to the organisation it has finally set up for a very hot pace has been set by Seaspeed in acquiring all the operating experience, commercial skills and public "image" necessary for the successful expansion to bigger things—the first of which will be the prototype BHC SR.N4 in the spring of 1968.

BRH no longer bothers to maintain the initial cover story, in the first ministerial announcement of its N4 order, that this 160-ton, 250-passenger, 32-car transporter will be operated for a learning period over the very short Solent routes, over which it would be vastly uneconomic, and which require frequent service from much smaller craft. Accordingly, proving trials have been held this month between various Channel points with Seaspeed's second N6, with no intention of putting this small vehicle on open-sea services but to assess the promise of various suggested terminal sites for an N4 operation. With this due to begin in the spring of 1968, construction of suitable terminals to make use of this craft's mixed-traffic abilities is required to begin within, say, six months and selection of routes and sites therefore becomes a relatively urgent business. Seaspeed's first N4 route is likely virtually to parallel an existing cross-Channel shipping link but to utilise the ACV's speed of turnround and amphibious capabilities by continuing to a third point at either the British or French end, over shoal inshore waters which have prevented similar exploitation by displacement craft. This will achieve some positive benefit from the amphibious capabilities, which is not evident on existing cross-Channel ACV links which, though improving on speed and frequency, simply parallel conventional shipping services. On the possibilities of operating entirely new routes which are impracticable with shipping, such as that between the south Essex shore and Calais suggested in our issue last January, BRH

1. *Seaspeed hovercraft sport the new British Rail symbol and colour, blue, on their topsides. Installation of Kelvin Hughes Type 17 radar, it is hoped, will lead to a reduction of minimum operating visibility from one nautical mile to a quarter-mile*

2. *General manager of British Rail Hovercraft, Mr Charles Brindle, is a qualified driver and intersperses administrative and planning duties with turns in the driving seat on regular services and proving runs*

3. *Employed normally in the reception/ticket selling/information role but travelling as stewardesses on charter and excursion runs are six uniformed hostesses. Miss Susan Jones deals with a passenger at the Cowes terminal*

3

"Air-Cushion Vehicles" photograph

DEC 13 1967

THE BOREAL INSTITUTE
LIBRARY

NEW FERRIES—TO MATCH NEW TRAINS . . .

general manager Charles Brindle is enthusiastic—in the longer term. He shares the feeling of other operators that inauguration of this type of route awaits the establishment of high standards of reliability—and multi-craft fleets. "With a one-craft fleet, such as our N4 operation will be in its first year," he said, "you must have an alternative means of travel available to passengers, such as the cross-Channel ships. You cannot lure them to some completely unserved area like south Essex and then strand them, without other links, if for some reason you cannot operate. With a larger fleet the picture is different—and south Essex makes good sense."

Meanwhile the Solent operation, conceived initially as a schooling period, is leading to the build-up of traffic which will be well worth retaining beyond 1968 and which is including thoughts of more suitable, larger mixed-traffic craft than the N6, with BH-7 as the first obvious replacement. The two terminals, at Crosshouse Road in Southampton, and at Medina Road in Cowes, have both been established relatively cheaply on leased land, the respective landlords being the Southampton Corporation and Westland/BHC. At both places 1:10 ramps have been built and prefabricated terminal buildings erected. That at Southampton is the £1,000 irreducible minimum of a small waiting room and lavatories; at Cowes a larger £2,000 building gives more waiting accommodation together with a buffet bar, and three small operating offices (the company's main offices are elsewhere in the town). Both the Southampton and Cowes terminals can be extended and together with buildings, concreting and terminal equipment, have been established in their present scale for £10,000.

Seaspeed is proud of operating the first all-bookable scheduled ACV service, accepting postal bookings direct from passengers or through BR offices and agents. It quickly encountered a regular traffic demand on the Southampton-Cowes route and shortly after opening, began to sell weekly season tickets, at £5, which represent a 33 per cent saving on single-journey fares (15s) if they are used for five-day commuting. There has proved to be commuting traffic originating both on the island and on the mainland and a number of season ticket holders at both ends of the route. With the reduction of services to the winter schedule of nine return crossings daily on September 5 Seaspeed has still been having reasonable passenger loads in recent weeks and it is rare to have spare seats on the morning crossings in either direction. Certainly, when *Air-Cushion Vehicles* crossed on the 10.50 a.m. on September 22 the craft was full, and was almost full for the return in mid-afternoon.

The introduction of a second route from Cowes to Portsmouth merely awaits the completion of a motorised pontoon which will occupy otherwise vacant berths against the Portsmouth Harbour Station floating pier, and which must be mobile to change from one berth to another to suit the rail ferry boats. This should be ready for services before the end of the year. The Cowes-Portsmouth operation, for which Seaspeed's second N6 completed proving trials before beginning this month's proving programme in the Channel, will be a new route in more ways than one, for there is at present no direct passenger link between these two towns and Seaspeed is interested in seeing whether a new traffic pattern will emerge. Some diversion from the railway's Portsmouth-Ryde ships may occur and, for the first time, Seaspeed will be operating a service with a direct physical connection with the railways—at Southampton a bus link is operated between the terminal and the Central Station. Overall times between Cowes and London will be cut.

The present Southampton-Cowes service operates in parallel with an existing shipping service—that of Red Funnel Steamers (Isle of Wight Shipping Co). Any traffic diverted off the conventional route by the appearance of the hovercraft has probably been made good, Mr Brindle believes, by the traffic-generating properties of the hovercraft — in the first season numerous holidaymakers have been tempted to make one-day trans-Solent outings, crossing by hovercraft one way (for the time saved and for the novelty) and returning by ship.

By the evening of October 10 36,713 passengers had been transported since the service was opened by the BRB chairman, Mr Stanley Raymond, on July 5—on what has been, to date, a one-craft service. Load factors have averaged about 52 per cent.

British Rail Hovercraft has been

4

4. The Medina Road, West Cowes, terminal is the larger of Seaspeed's present two bases, and includes operations offices and a buffet bar

5

5. N6s 009 and 011, Seaspeed's present fleet, on the Cowes apron. In the background is the main BHC factory. Only 011, left, has been used on services to date, 009 being employed for proving and training and now to be refurbished to BRH standards before a commercial career

"Air-Cushion Vehicles" photographs

6. Capable of extension, Seaspeed's Southampton terminal occupies what was waste land on the side of the River Test and opposite the BHC works at Itchen. Here the beachmaster guides in the third arrival of the day. Refuelling is normally done at Southampton; two 200gal fillings sufficing for the nine-round-trip winter operating day "Air-Cushion Vehicles" photograph

set up to investigate thoroughly the costs and problems of ACV operation, to assess their commercial promise, and to smooth the way for a possible big entry into the field by BR shipping services (which has one of the world's largest narrow-sea fleets). This aim is being taken very seriously indeed and the emphasis is strong on the company truly showing overheads and not presenting too rosy a picture by concealed subsidies resulting from its connection with the railways. Thus, while it is to a very large degree self-sufficient, it uses certain BR common services but pays for them—and uses them only if they are as cheap, or cheaper, than what is available elsewhere or what it can do itself. The Seaspeed posters which have appeared in recent months to publicise the services from British Rail billboards at stations all over the country are no free gift from a beneficent British Railways Board to the ACV subsidiary—they are a firm debit item in the company's accounts, as is the rental for the billboards they occupy. Similarly, the services of British Rail's public relations organisation have sometimes been used—and paid for, but lively sales promotion, including direct mail advertising campaigns and other publicity shots, has also been mounted by Mr Brindle and his staff from within the company and has had notable success in the Isle of Wight and the adjacent mainland.

Seaspeed recently took delivery of its second N6 which, like its first, is an ex-Scanhover machine leased from Westland Charters. Delivery was taken of the craft as it stood, for its use on proving trials, and it is shortly to be returned to BHC for a complete refurbishing and furnishing in the BRH scheme. The company's strongest argument, in presenting a case to its BRB masters for a second machine for its "learning" period, was a telling one with any transport man—that of a one-horse stable, a one-bus garage, or a one-N6 ACV operation being excessively vulnerable to service cancellations through snags. But another argument advanced in successfully stating the case reflects the company's high commercial mindedness and determination to probe fully the economic potential of ACVs; it wanted to be in a position to evaluate charter demand, both for regular contract charters and *ad hoc* general charters. It also intends, when opportunity allows, to generate additional business with "excursion" runs.

An example of this approach was an excursion arranged (with all seats sold) to accompany the fleet on the Cowes-Torquay powerboat race in August—a day's outing and a magnificent view promised for £10 a head, with catering thrown in. In the event the run had to be cancelled the day before, when the weather was so execrable that even the race itself appeared doubtful. In fact the race *was* run in horrible conditions, and passengers on the regular services were asked, over the cabin address, whether they would like the journey lengthened by some minutes to get a view of the boats returning to Cowes. Unanimously, they opted for this and their journeys were enriched by their overtaking, effortlessly, extremely expensive powerboats, to the ire of the sailors, some with broken limbs and all with hammered stomachs, who were aboard them.

The present strength of the company numbers 24, including Mr Brindle. These comprise ex-RN aircraft engineer John Lefeaux, the chief engineer, who has a staff of four; three drivers (with a fourth about to be recruited), five beachmasters, six hostesses, a finance and survey officer, who acts as company accountant and who also collects and collates the operating and commercial data; one operations officer, and two office girls. Both Charles Brindle and John Lefeaux have qualified as drivers and take services as and when necessary. The most experienced driver is the ex-Scanhover commander and now BRH chief driver Hermod Brenna-Lund, a Norwegian mariner whose experience in N6s can also be set against considerable experience as a navigator and commander aboard PT-20 hydrofoils operating commercial services in Scandinavia. He is thus probably unique at the present time in having substantial command experience on both types of advanced marine craft.

Jobs in BRH are initially offered inside British Rail, and particularly within the shipping division, before being advertised outside. While it is felt right that BR people should have first crack at available jobs—particularly those whose own jobs, ultimately, might become redundant with an increase in hovercraft activity—the proviso is strictly enforced that they be well qualified and as good material as that available outside. One example is a BR mariner who took a private pilots' licence, at his own expense, to be better qualified for consideration as a hovercraft driver.

In his engineering personnel, chief engineer John Lefeaux has sought for sound aircraft maintenance experience, with Service training, as well as relevant experience in civil life. That he has so far found it is borne out by the fact that in his four-strong force of fitters are ex-RN, RAF *and* Army aircraft-maintenance tradesmen.

Mr Lefeaux cites the same trouble, skirt wear, as does any other engineer who has been concerned with maintaining ACVs in operation, when asked what the main snags have been to date. Engine and systems reliability has been in general very satisfactory and the engine of N6/011 is now being sampled to 1,250hr as a step in the programme to increase the Marine Gnome TBO. Action is necessary, he feels, to increase component lives and to reduce engine costs, after which even the small N6 would look a viable proposition. That engine life is a major factor is borne out by the fact that about 80 engine hours are logged in one week by one craft on the summer schedule, of which about 60 are full-rating hours.

The company originally chose the Solent as its first operating arena for the fact that the Solent/N6 combina-

NEW FERRIES—TO MATCH NEW TRAINS . . .

tion resembles very closely the N4/narrow seas combination, from the point of view of weather limitations and thus was particularly apt as a "laboratory model" of the N4 services which the company is to pioneer. Another factor which favoured the choice of Southampton-Cowes was the density of traffic there—Southampton Water has 15,000 shipping movements a year, and there are numerous small craft at most times—and the company particularly seeks to evaluate ACV behaviour in congested areas. There are, however, numerous other potential operating areas in Britain which excite the company's interest—the Thames Estuary and Bristol Channel are an obvious two—and various assessments are being made of opportunities around the coasts. Seaspeed and BH-7 have not yet been linked in any official statement but at Cowes the company makes no secret of its interest in the forthcoming BHC project, and its 80-ton follow-up. Having established a regular clientele on the pilot route, with every indication that traffic will continue to grow satisfactorily, it is unlikely that the company will quit the Solent entirely when it has N4 preoccupations elsewhere.

Farther afield, Seaspeed, in common with other pioneer ACV operators, is assessing opportunities of "chasing the sun" and employing spare winter-season capacity profitably in winter holiday areas. The Caribbean is one obvious area for extensive examination and the eminently shippable nature of ACVs, which are built to encounter greater weathering from spray than they will normally encounter as items of deck cargo, makes the summer-at-home, winter-abroad approach to commercial viability particularly promising. If the company does elect to mount such an operation, far away from any existing BR sphere of interest, it expects some parliamentary grumbling from the anti-nationalisation lobby, which is ever ready to pounce on any evidence of commercial opportunism by State-owned industries. Equally, its expects such criticism to be nullified by those who wish to see BR's initial association with ACVs prosper and grow.

Apart from the limitations which the opponents of State enterprise might seek to impose on Seaspeed in particular, Mr Brindle strongly opposes, with a fervour which will be echoed by other ACV operators, any suggestion that hovercraft services should be licensed and regulated, or licensed and inhibited (according to one's point of view) by a body analogous to the Air Transport Licensing Board. Ships are traditionally free to ply commercially as and where their owners think it is profitable for them to do so; as competitors of shipping services ACV operators should at least have equal freedom to find a living where they may, he argues.

Mr Brindle is one of the executives recruited by BR from outside industry in the early days of the Beeching era to enliven the railways' commercial approach. He has followed a very varied career which, early on, saw him in the Merchant Marine with a master's ticket and which subsequently has taken him into engineering and technical sales and, more recently, into sales promotion with BR. While well aware of the opportunities which the railways connection will give the company, he is insistent that it should create its own ethos of professionalism, reliability and skill appropriate to the latest means of transport, and not be handicapped by any soot and navy serge image which still attaches to the railways. The uniforms of driving and terminal personnel are smartly worn and are more akin to airline rigs than to the aforementioned navy serge—or to the unhappy field-grey, Wehrmacht-style uniforms which are replacing it elsewhere in BR. The terminals are clean and bright and rather than pushing money to a face at a hole in the wall, railway-station style, passengers buy tickets from a uniformed "hostess" sitting at a desk in the waiting area. There are indications that no commercial chance is being lost, for Seaspeed pennants and postcards can be bought at the same desk. At the Cowes buffet, in the open-plan waiting lounge, the coffee comes fresh and good—and in a china cup. Once aboard and under way, passengers are given a short "patter" by the driver—yes, the ubiquitous Captain Speaking is now air-cushion-borne. Such patter gives estimated journey time and points out particularly interesting shipping movements and, near the journey's end, hopes to see the passengers again. At disembarkation, the treatment is equally swift and courteous. This service shows no sign of improvisation. Swifty born, it has soon grown up.

And in the buffet car of the train back to town, the pay-off comes. As one eats a tired plastic sandwich out of a plastic wrapper and drinks palatable coffee spoiled by a repellent and pinch-penny plastic cup, one realises that British Rail Hovercraft is separated from the mass of British Rail by more than its self-contained accounts, the Solent and the vehicles that it operates. A fourth distinction is that it believes the passenger really deserves something good and works hard to see he gets it.

7. *Careful low-turbine-speed approach and departure procedures between the Cowes terminal and the harbour entry marker have been adopted from the outset to minimise noise. Slipway gradients are 1:10 and the growth of slimy seaweed over the lower portions is encouraged as a lubricant to reduce skirt wear*

8. *Arrival at Cowes, with Charles Brindle seeing the passengers out. Twenty minutes is the time given in the published timetable for the 13 n.m. journey between Southampton and Cowes, but it is more often completed in nearer 15 minutes. Maximum speed limitation is 55kt*

"Air-Cushion Vehicles" photograph

7

8

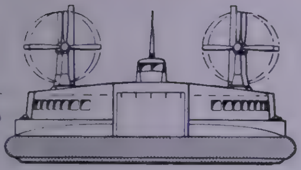
Printed in Great Britain by Gibbs and Bamforth, St. Albans, Herts. RP 2316/7

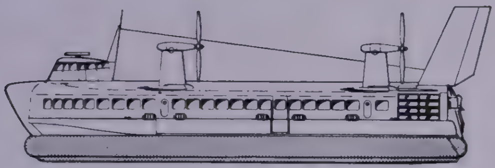
Pam. 629.1.039 B.H.C. L 26.

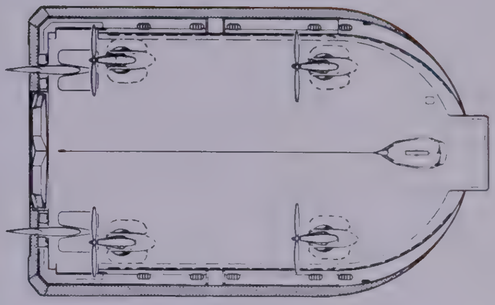
THE BOREAL INSTITUTE
LIBRARY

DEC 13 1967

SR.N4







The 165-ton SR.N4 hovercraft is a fast passenger/car ferry designed for operations on 'open-sea' ferry routes.

Its spacious deck area can be varied to suit an operator's requirements. Typical layouts include all-passenger versions carrying 500 people seated or 700/800 commuter passengers on short routes and a passenger/car version carrying 256 people seated and 30 cars. In addition, SR.N4 can be used to carry freight.

Large doors in the bow and stern greatly facilitate loading and unloading; 'turn-round' time thus being extremely short.

Fitted with 7 ft. skirts, SR.N4 will be capable of operating in 10 ft. seas normally the maximum sea state envisaged for open water routes such as the English Channel. In calm weather, it can carry a disposable load of 63.5 tons at a maximum cruising speed of 70 knots over distances of up to 290 n. miles.

Power for its lift/propulsion system is provided by four 3,400 s.h.p. Bristol Siddeley 'Marine Proteus' gas turbine engines located in the stern.

Being a truly amphibious craft, SR.N4 can operate from relatively simple bases located above the high water mark away from congested port areas, irrespective of the state of the tide and the water depth. This greatly reduces capital costs as well as enhancing operational flexibility. Operation from existing harbour installations can be arranged with a minimum of alteration.

Two SR.N4's have been ordered by the Swedish Lloyd Line and the Swedish American Steamship Co. for use on a passenger/car ferry service between Ramsgate and Calais in 1968.

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with Westland Aircraft Limited'.

WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

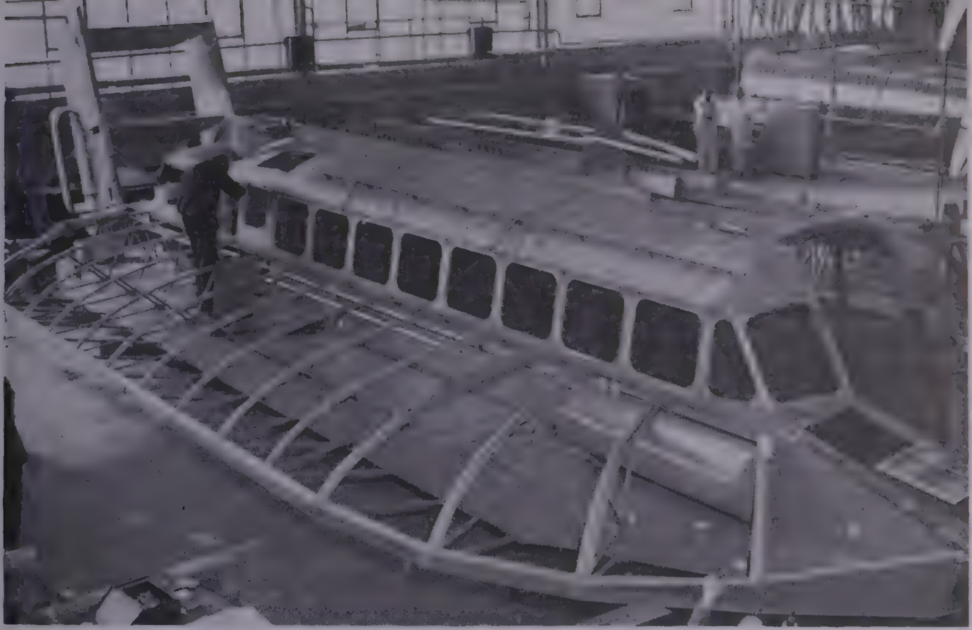
LEADING PARTICULARS

	DIMENSIONS
Overall length	130' 2" (39,68m.)
Overall beam	76' 10" (23,46 m.)
Overall height on landing pads	42' 5" (12,95 m.)
Passenger/Vehicle floor area	5,800 sq. ft. (539 sq. m.)
Vehicle deck headroom (on centre line)	11' 6" (3,51 m.)
Bow ramp aperture (height x width)	11' 6" x 18' (3,51 m. x 5,48 m.)
Stern door aperture	31' x 11' 6" (9,45 m. x 3,51 m.)
Skirt length–basic craft	7' (2,1 m.)
	POWER PLANT AND SYSTEMS
Main engines	4 x Bristol Siddeley 'Marine Proteus'
Max. continuous rating at 15° c	4 x 3,400 s.h.p. (4 x 3.447 cv)
Auxiliary power units	2 x Rover IS/90 gas turbines
Propellers	4 x 4-blade, variable pitch 19 ft. dia. (5,79 m.)
Lift fans	4 x BHC centrifugal 11 ft. 6 in. dia. (3.5 m.)
Fuel capacity	4,500 Imp. gall. (20. 456 litres)
	WEIGHTS
Disposable load	63.5 tons (64,5 tonnes)
Normal gross weight	165 tons (167,6 tonnes)
Maximum gross weight	185 tons (187,9 tonnes)
	PERFORMANCE (at 165 tons normal gross weight at 15°c)
Maximum still air speed over calm water (max. power)	77 knots (148 km/hr)
Maximum speed over calm water (max. cont. power)	70 knots (133 km/hr)
Speed in 4–5 ft. waves	55–65 knots (102–120 km/hr)
Speed in 8–10 ft. waves	20–30 knots (37–56 km/hr)
Still air range	290 n. miles (540 km)

YEOVIL ENGLAND
british hovercraft corporation limite

B.H.C. 2.7
Pam. 629.1.039

Reprinted from the
"Air-Cushion Vehicles"
supplement to
FLIGHT
International
25 March 1965



The prototype N6 photographed on March 10. Beside the driver's station is one of the two forward tanks of the fuel-ballast trimming system. To make its first runs in April, the craft will undertake two months' trials, including proving of optional systems, before delivery to Scan-Hover, scheduled for June

SR.N6

A NEW 38-seat hovercraft, the Westland SR.N6, is to make its first appearance during the first days of April, having been announced by the company on March 2. Structurally and mechanically the new craft is a stretched development of the 18-seat SR.N5, incorporating unchanged many structural and all the dynamic components of the smaller machine and, indeed, being built in the same jigs at Cowes. But the basic conception of the new craft differs from that of the N5, which was described in detail in our July 1964 issue. The N5 is a very versatile, go-almost-anywhere machine with a high thrust-to-weight ratio and very considerable overland and gradient-climbing capability. The N6 has been optimized purely for the overwater role and, while possessing sufficient gradient performance to operate from normal slipways and roughly cleared beaches, it sacrifices the N5's overland versatility, not required by commercial ferry operators, in return for much improved economics.

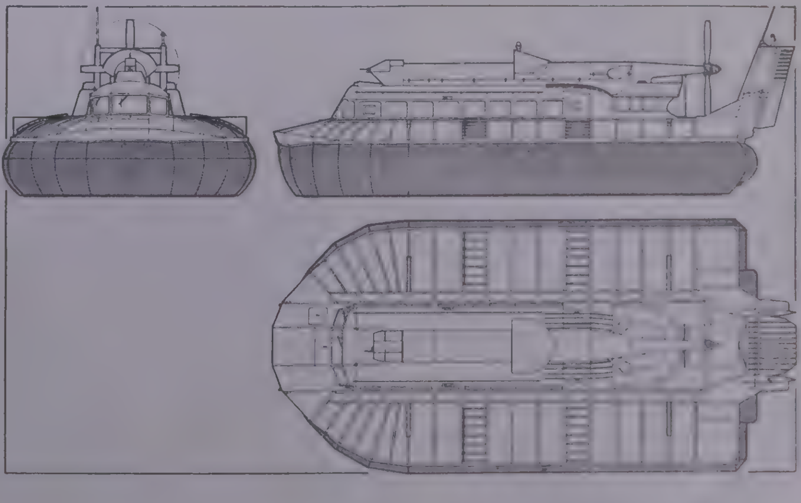
Seating capacity has been doubled for the same engine/9ft propeller/7ft fan combination without, it is confidently expected, impairing the overwave performance at all, 40-50ft in 4-5ft seas, so it is apparent that a very substantial advance in economics is being made. Cushion pressure remains the same, 30lb/sq ft at normal gross weight, 20,400lb.

Structurally, the N6 is simply a 9ft 8in stretch of the N5 with four between-frame bays being added forward of the cabin rear bulkhead and incorporating four more windows on each side. Other changes are confined to systems, are not extensive and mainly concentrated on the cabin roof. The flat-plate forward dorsal fin of the N5 is replaced on the N6 by a capacious longitudinal casing, extending forward of a raised halo-type engine air intake. (Other engine intakes on the sides of the fan intake remain.)

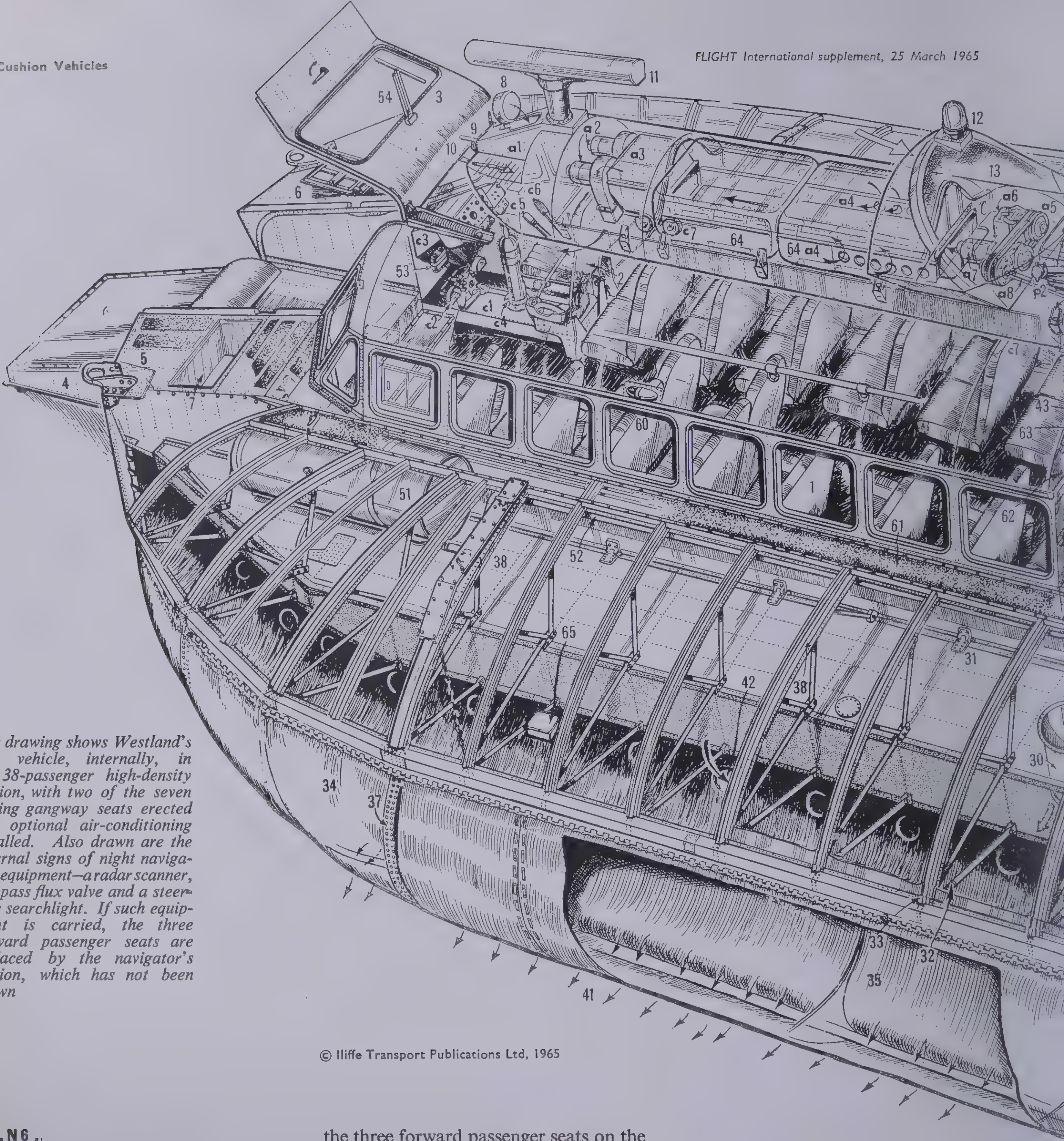
Within the dorsal casing a forced-draught cabin ventilation system with a forward-facing Venetian blind intake and two 12in recirculating fans replaces the simple mushroom ventilators of the N5. Compressor bleed air from the BS Gnome gas generator is ducted forward to a mixer unit through which the forced draught passes for cabin heating. An air-conditioning system is an optional fit, with standard Normalair vehicle air-conditioning condensers and evaporators installed in the roof ducts. Housed in the casing forward of the halo intake are two 21-man inflatable dinghies. The capacity of the fuel-ballast fore-and-aft trimming system is increased from 40 to 100gal.

Normal cabin furnishing of the N6 is 31 fixed seats, with seven folding gangway seats. Luggage is housed in two stern panniers of approximately 75 cu ft capacity. The quick-release seat attachments in the floor serve the dual function of freight lashing points, numbering 30 in all and arranged in an approximate lashing grid of two rows, 4ft apart at 14in pitch.

The electrical system remains standard with that now fitted in production N5s, namely, a Westinghouse FA14 140A 30V brushless generator, normally belt-driven, but driven through an accessory gearbox off the condenser drive shaft on air-conditioned machines,



DEC 13 1967
THE BOREAL INSTITUTE
LIBRARY



This drawing shows Westland's new vehicle, internally, in the 38-passenger high-density version, with two of the seven folding gangway seats erected and optional air-conditioning installed. Also drawn are the external signs of night navigation equipment—a radar scanner, compass flux valve and a steerable searchlight. If such equipment is carried, the three forward passenger seats are replaced by the navigator's station, which has not been drawn

© Iliffe Transport Publications Ltd, 1965

SR.N6 ..

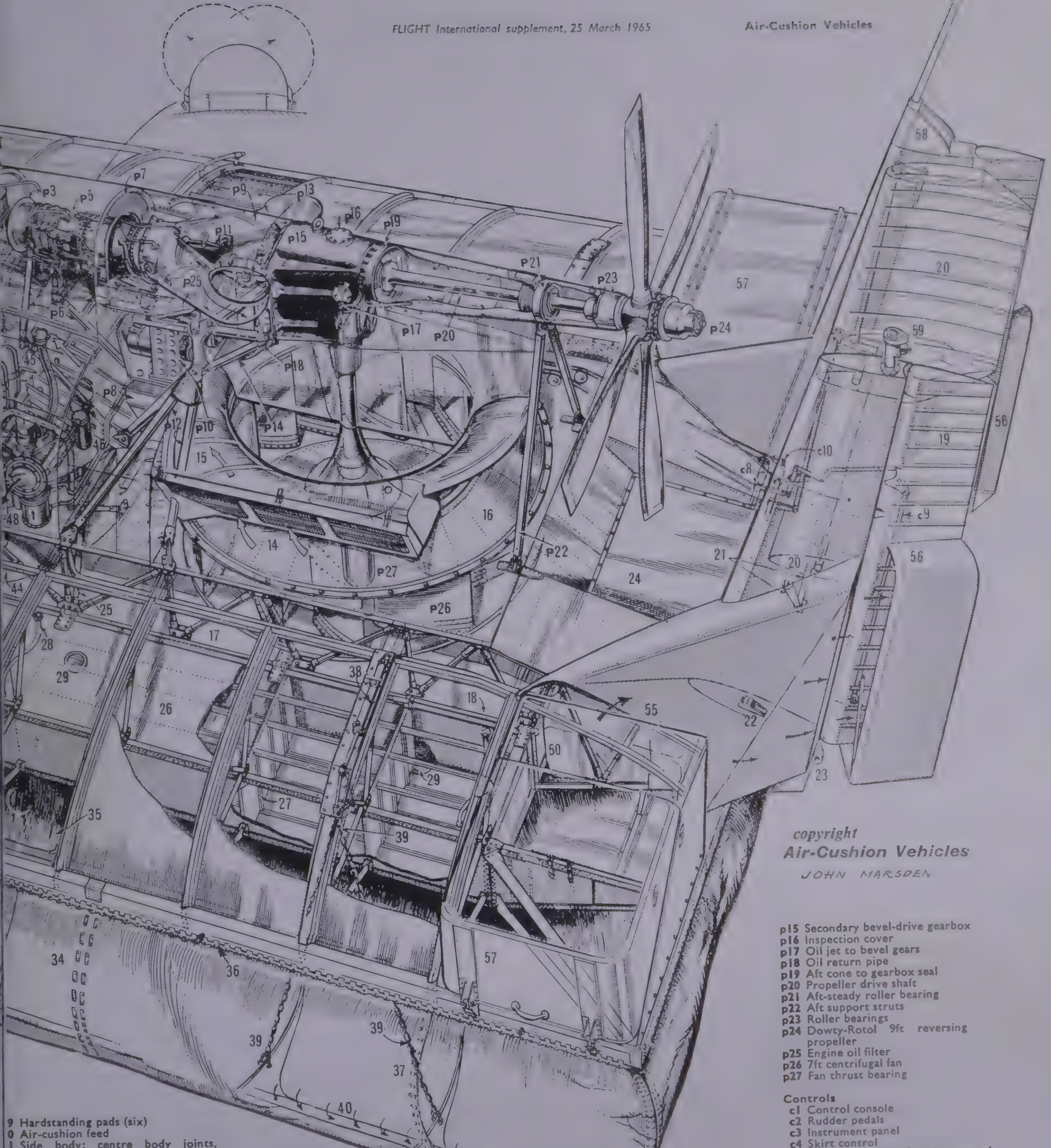
with a static regulator, protective over-voltage relay, and a rotary inverter to supply the gyro compass. Most electrical system components are housed in a special bay on the starboard side, immediately aft of the cabin bulkhead, and the 40A/hr battery is placed forward, under a foredeck hatch.

This system provides adequate power, without special boosting, for night navigation equipment. The prototype N6, 009 off the now joint N5/N6 production line, is to be equipped for night operations, with a Kelvin Hughes Type 17 marine radar. The 360° rotating scanner will be carried on a short mast at the forward end of the dorsal spine, with the display and transceiver mounted in a second crew position which replaces the three forward passenger seats on the port side.

A Sperry CL-2 gyro-magnetic compass system is installed, with the master indicator mounted directly above the radar display and providing a direct feed to stabilize the radar picture north upward. The gyro unit is mounted directly in front of the driver, beneath the instrument panel, with the compass control box on the cabin wall beside him. Redifon VHF FM marine radio is a standard fit, and there is an intercom between the driver and navigator.

Another night aid is an electrically operated steerable searchlight, at the foot of the radar scanner mast. This light folds backwards into a housing when not in use and is controlled by the driver through a four-position switch, selecting extension or retraction and left or right in azimuth. In other respects

1 Passenger cabin
2 Driver's position
3 Top-half entrance door
4 Lower-half entrance door, forming loading ramp
5 Towing and mooring points
6 Battery locker (24V, 40A/hr)
7 Anchor stowage
8 Searchlight
9 Pitot head
10 Forward steaming light
11 Radar scanner
12 Amber rotating beacon
13 Engine ram-air intake with knitmesh filter
14 Main engine air intake with knitmesh filters (airflow follows white arrows)
15 Glass-fibre moulded fan intake
16 Upper fan-cone casing
17 Plenum chamber
18 Centre buoyancy tank
19 Rudders
20 Elevators
21 Fin-support tubes
22 Fin attachment points
23 Aft mooring points
24 Servicing platform, propeller and aft control surfaces
25 Plenum-chamber support bracing tubes
26 Side buoyancy tanks
27 Reduxed Z-stringers
28 Buoyancy tank vents



copyright
Air-Cushion Vehicles
JOHN MARSDEN

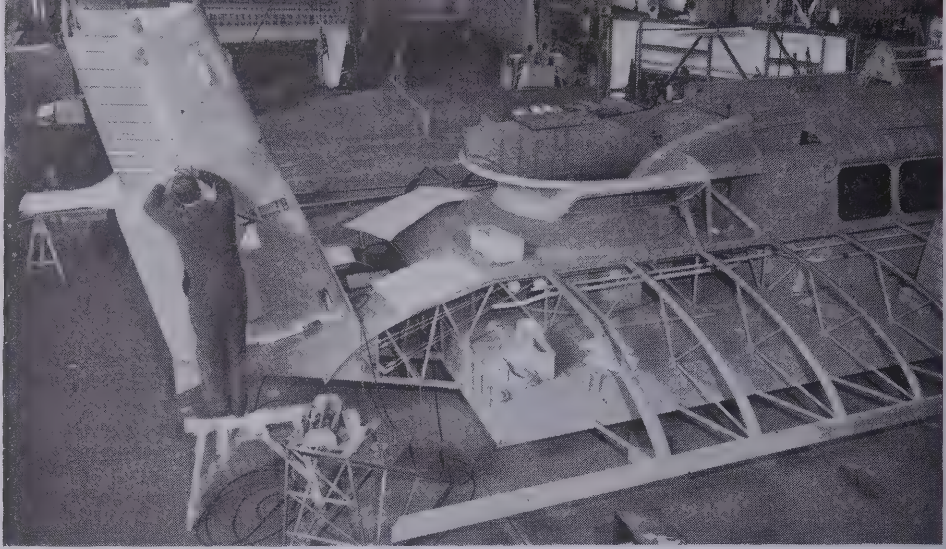
9 Hardstanding pads (six)
0 Air-cushion feed
1 Side body: centre body joints, quickly released for transporting craft
2 Tubular outriggers
3 Outer-body support frames
4 4ft deep flexible skirt (6ft lengths can be lifted independently)
5 Skirt inner wall
6 Piano-hinge skirt attachment
7 Bolted skirt joint
8 Skirt-retraction jacks (four)
9 Skirt-retraction chains in down position
10 Air curtain, skirt down
11 Spilled cushion air
12 Skirt spill holes
13 Fuel-bay access panel
14 Main fuel tank bay (265 Imp gal carried in flexible bag)
15 Fuel filler cap
16 Fuel filter
17 Electrically driven l-p fuel pump (delivering to engine h-p pump)
18 Oil cooler
19 Oil cooler air outlet

50 Aft fuel-ballast tank
51 Forward fuel-ballast tank (port and starboard)
52 Fuel-ballast transfer pipe
53 Windscreen wash reservoir
54 Electrically driven windscreen wipers
55 Bleed duct to bucket rudder
56 Bracket rudders
57 Panniers
58 VHF radio mast
59 Aft steaming and mooring lights
60 Navigation lights
61 Non-slip walkways
62 Fire zone
63 Fire-suppression bottles
64 Two inflatable liferafts
65 Compass flux valve

Powerplant
p1 Oil tank
p2 Oil-tank filter
p3 Engine air intake
p4 Hinged access panels (opening either side)
p5 Bristol Siddeley Marine Gnome
p6 Engine-support tubes
p7 Engine-bay firewall
p8 Engine-bay venting filter
p9 Bifurcated exhaust ducts
p10 1.6kW generator and mounting (cog-belt drive)
p11 Primary engine-reduction gearbox
p12 Aft-mounting support tubes
p13 Secondary gearbox drive-shaft
p14 Secondary gearbox bracing struts
p15 Secondary bevel-drive gearbox
p16 Inspection cover
p17 Oil jet to bevel gears
p18 Oil return pipe
p19 Aft cone to gearbox seal
p20 Propeller drive shaft
p21 Aft-steady roller bearing
p22 Aft support struts
p23 Roller bearings
p24 Dowty-Rotol 9ft reversing propeller
p25 Engine oil filter
p26 7ft centrifugal fan
p27 Fan thrust bearing

Controls
c1 Control console
c2 Rudder pedals
c3 Instrument panel
c4 Skirt control
c5 Propeller pitch and engine controls
c6 Elevator control lever
c7 Control runs (outside cabin wall)
c8 Rudder controls
c9 Rudder inter-connecting rod
c10 Elevator controls

Air conditioning (to customer's requirement)
a1 Fresh-air inlet (Venetian-blind shutters)
a2 Air circulating fans (standard)
a3 Evaporator and water extractor
a4 Fresh-air and recirculating ducts (air down both sides, through holes and up the centre)
a5 Air-from-cabin duct (tube along starboard side of engine fairing to eye of fan)
a6 Compressor
a7 Generator
a8 Compressor and generator gearbox and drive shaft



Rear-end details, showing the fan intake and one of the flanking engine air intakes, which here does not have its spray/sand extractor fitted. These side intakes are supplemented by a forward-facing intake above the dorsal casing and out of the picture. Main luggage accommodation is two stern panniers flanking the fins

the driver's station will be identical with that of N5.

Design has been completed for an alternative, Decca, radar installation and mounting lugs are being provided in the basic production craft, for radar to be easily fitted at any time retrospectively.

Westland has set itself a tight schedule for trials. Following the first sorties in April, the prototype is intended to be delivered to the Norwegian operator Scan-Hover in June complete with full ARB approval. The air-conditioning system will initially be installed on the machine, for the approval trials, and subsequently removed as it is not required by the Norwegian purchaser.

Close behind the first N6 is the second, 010 on the line, earmarked for Highland Engineering Ltd, intending operator of ACV ferry services on the Clyde.

Subsequently, any machine in the second N5 production batch, ten machines, which has already been laid down, may be completed as an N6, according to the sales demand. It is expected that ferry operators who have already considered the N5 will automatically switch to favouring the larger and potentially more profitable machine, but further sales opportunities for the N5 in contexts where its exceptional overland versatility is required are foreseen, particularly in the military field.

No price has yet been announced for N6 and no economic estimates have been released by Westland. It would, however, be surprising if the new machine does not halve the direct passenger-mile operating costs on which short-sea ACV ferry proposals have hitherto been based.

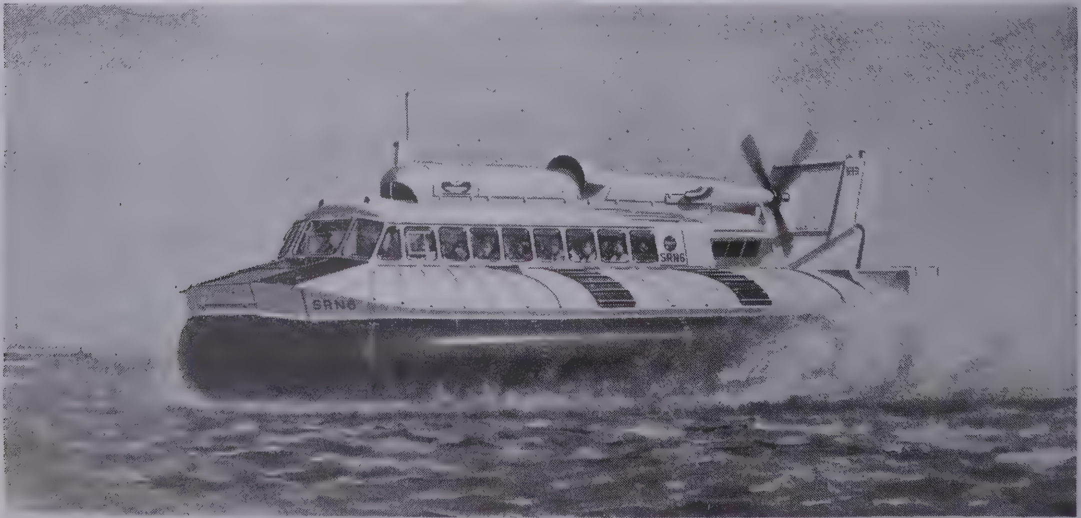
WESTLAND SR.N6

Bristol Siddeley Gnome, Series 1051, 1,050 s.h.p. max rating, 900 s.h.p. max continuous rating

Dimensions Length, 48ft 5in; beam, 23ft; height on landing pads, 13ft 11in; height from skirt hemline (hovering), 17ft 4in; cabin length, 21ft 8in; cabin width, 7ft 8in; cabin floor area, 166 sq ft; door aperture height, 5ft 9in; door aperture width, 3ft 3in; skirt length, 4ft; cushion area, 673 sq ft; cushion loading at 9 tons gross, 30lb/sq ft; usable fuel capacity 265 Imp gal.

Weights Equipped as high-density transport: basic weight, 11,800lb; disposable load, 8,600lb; normal gross operating weight, 20,400lb. Equipped as freight transport: basic weight, 11,200lb; disposable load, 9,200lb; gross weight, 20,400lb. Overload case: disposable load, 11,800lb; gross weight, 23,000lb. Massive overload case: disposable load, 16,800lb, gross weight, 28,000lb.

Performance (38-passenger transport operating at 60-80 per cent load factor, approximately half the fuel used, ISA conditions) Max speed, calm water (1,050 s.h.p.), 64kt; max speed, calm water (900 s.h.p.), 61kt; speed in 4-5ft waves, 40-50kt; time to 50kt, 41sec; normal stopping distance from 50kt, 260yd; emergency ditching distance from 50kt, 120yd; normal turn radius at 40kt, 380yd; "skirt turn" radius at 40kt entry speed, 160yd; endurance at max continuous power, 3.6hr; calm water range, 220 n.m.; max height of vertical step or wall, 3ft 6in; maximum height of rounded rock groyne, 4ft; maximum height of shingle bank, 6ft; negotiable gradient from standing level start, 1 in 9.



POLAR
PAM
4646

POLARPAM

Printed in England by Centrebind Ltd. Loughton, Essex RP 1505

629.1.039.

H.R.c. P.R.

BHC

BUDGETARY COSTS
for
CIVIL AIR CUSHION VEHICLES

SR.N5

SR.N6

SR.N4

BROCHURE B.385
JANUARY 1967

Pam. 629.1.039

POLAR
PAM
4646

POLARPAM

BRITISH HOVERCRAFT CORPORATION LTD., YEOVIL, ENGLAND.

THE BOREAL INSTITUTE
LIBRARY
NOV 6 1967

CONTENTS

Section No.	Description	Page No.
1.	Introduction	1
2.	Initial Costs	
	(a) SR.N5	2
	(b) SR.N6	4
	(c) SR.N4	6
3.	Direct Operating Costs	
	(a) SR.N6	8
	(b) SR.N4	10
4.	General Notes	12
5.	Conditions of Sale	13

BUDGETARY COSTS - CIVIL CRAFT

1. INTRODUCTION

1. In this brochure, price indications are given for the range of Air Cushion Vehicles now in production at the factories of the British Hovercraft Corporation.

2. All prices given are approximations, given for Budgetary purposes and are subject to revision by formal quotations which will be provided on request.

3. All sales are subject to the company's Standard Conditions of Sale, details of which are given on Page 11.

4. Initial costs are given for the sale of one A.C.V. of each type. If two or more craft are ordered, the cost of ground equipment, special tools and spare parts will be considerably less per craft purchased than in the case of the purchase of a single craft.

5. The equivalent costs given in U.S $ are based on an exchange rate of 2.8 U.S $ to the £ sterling. When the current rate differs, adjustment should be made accordingly.

6. Details are also given of Direct Operating Costs. These are approximations only, and may be more, or less, depending upon the following factors:

   (i) Number of craft being operated

   (ii) Type of route

   (iii) Experience of operating and maintenance crews

   (iv) Local rates of salaries

   (v) Local fuel costs

   (vi) Period of time craft have been operating on the service. As a general rule, operating costs may be expected to be reduced after the craft have been in service with an Operator for one or two years.

BUDGETARY COSTS - CIVIL CRAFT

2. Initial Costs

(A) SR.N5

Item No.	Item	Approximate Cost £ Sterling	U.S. $	Local currency
1.	One SR.N5 A.C.V. fitted with standard specification equipment	88,700	248,360	
2.	One set of Operational equipment as detailed on Page 3	12,880	36,064	
3.	Ground Equipment, Special Tools and Spare Parts (i) Ground equipment (ii) Special Tools (iii) Spare Parts	15,000	42,000	
	Total cost of one SR.N5 A.C.V. complete with operational equipment, ground equipment special tools and spare parts.	116,580	326,424	

Alternative Methods of Payment Available

(i) Direct Sale

25% deposit on signature of contract

Balance on delivery of goods

Note: A small discount is available on prices quoted in paragraph 1 above, for a direct sale.

(ii) Payment over 5 year period

Interest charges are added to prices given in paragraph 1 above.

20 % of initial value of order deposited on signature of contract.

Balance payable in ten 6 monthly payments, the first of which is payable six months after delivery of craft.

SR.N5

List of Operational Equipment

Item	Description
1.	Interior cabin sound proofing and trim excluding seats
2.	Fixed seats for 18 passengers complete with ashtrays
3.	Redifon radio type GR.289 Mk.2 complete with 2 head sets
4.	Air Conditioning System (no heating)
5.	Complete Kelvin Hughes Radar Installation including :- Kelvin Hughes Radar Installation Radar Operator Station Blackout partition Gyro Compass Rate of turn indicator
6.	Installation of safety glass window wiping and washing on port side
7.	Magnasyn compass installation
8.	One 21 seat dinghy
9.	19 Life jackets
10.	Signal pistol and stowage
11.	Aldis signalling lamp and stowage
12.	First aid box and stowage
13.	Fire Axes (2)

TOTAL - One set of Operational Equipment - £12,880

U.S. $ - 36,064

BUDGETARY COSTS - CIVIL CRAFT

(B) SR.N6

Item No.	Item	Approximate Cost £ Sterling	 U.S. $	 Local Currency
1.	One SR.N6 A.C.V. fitted with standard specification equipment	114,500	320,600	
2.	One set of operational equipment as detailed on page 5	14,650	41,020	
3.	Ground Equipment, Special Tools and Spare Parts			
	(i) Ground equipment	6,250	17,500	
	(ii) Special tools	550	1,540	
	(iii) Spare Parts	9,100	25,480	
	Total cost of one SR.N6 A.C.V. complete with operational equipment, ground equipment special tools and spare parts	145,050	406,140	

Alternative Methods of Payment Available

(i) Direct Sale

25% Deposit on signature of contract

Balance on delivery of goods

Note: A small discount available on prices quoted in Paragraph 1 above, for a direct sale.

(ii) Payment over 5 year period

Interest charges are added to prices given in Paragraph 1. above.

20% of initial value of order deposited on signature of contract.

Balance payable in ten 6 monthly payments, the first of which is payable six months after delivery of craft.

SR.N6

List of Operational Equipment

Item	Description
1.	Interior cabin sound proofing and trim excluding seats
2.	Fixed seats for 38 passengers complete with ashtrays
3.	Redifon radio type GR 289 Mk.2 complete with 2 head sets
4.	Air conditioning system (no heating)
5.	Complete Kelvin Hughes Radar Installation including :- Kelvin Hughes Radar Installation Radar Operator Station Black out partition Gyro compass Rate of turn indicator
6.	Installation of safety glass window wiping and washing on port side, Modification N6/100
7.	Magnasyn compass installation
8.	Two 21 seat dinghies
9.	41 Life jackets
10.	Signal pistol and stowage
11.	Aldis signalling lamp and stowage
12.	First aid box and stowage
13.	Fire axes (2)

TOTAL - one set of operational equipment - £14,650

U.S. $ - 41,020

BUDGETARY COSTS - CIVIL CRAFT

(C) SR.N4

Item No.	Item	Approximate Cost £ Sterling	U.S. $	Local Currency
1.	One SR.N4 A.C.V. equipped with normal operational equipment for car ferry role, including : seats, radio, navigational aids including radar night operational equipment, safety equipment	1,638,000	4,586,400	
2.	Ground equipment, special tools and spare parts, including one spare Proteus engine	225,000	630,000	
	Total cost of one SR.N4 A.C.V. complete with operational equipment, ground equipment and spare parts	1,863,000	5,216,400	

Alternative methods of payment available

(i) Direct Sale

25% Deposit on signature of contract

Balance on delivery of goods

Note: A small discount available on prices quoted in paragraph 1. above, for a direct sale.

(ii) Payment over 7 year period

Interest charges are added to prices given in Paragraph 1. above.

10% deposit on signature of contract.

BUDGETARY COSTS - CIVIL CRAFT

A further 10% deposit 12 months after signature of contract.

Balance payable in fourteen 6 monthly payments the first of which is payable 6 months after delivery of craft.

BUDGETARY COSTS - CIVIL CRAFT

(A) SR.N6

3. Direct Operating Costs (per hour)
(D.O.C.)

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	£ Sterling	U.S $	Local	£ Sterling	U.S. $	Local
Depreciation (7 years with 25% residual value)	10.4	29		7.8	22	
Interest (5% of mean value)	3	8.4		2.3	6.4	
Insurance (2½% of initial value) (including 3rd party but not passenger)	2.1	5.9		1.6	4.5	
Crew (Commander and one Crewman)	3.7	10.3		4.5	12.6	
Fuel and Oil (at 15d or 17 cents per Imp.gallon)	4	11.2		4	11.2	
Maintenance Costs						
Engine	9	25		9	25	
Skirt	4	11.2		4	11.2	
Transmission	1.8	5.1		1.8	5.1	
Propeller	2	5.6		2	5.6	
Structure	1	2.8		1	2.8	
Labour	2	5.6		2	5.6	
TOTAL	43	120		40	112	

BUDGETARY COSTS - CIVIL CRAFT

	ANNUAL UTILISATION					
	1500 hrs			2000 hrs		
	Approximate cost					
	Pence	U.S. Cents	Local	Pence	U.S.Cents	Local
D.O.C. per passenger n.m (100% load factor. 40 knots block speed 38 passenger capacity)	6.8	7.9		6.3	7.4	

Note: The hourly Direct Operating Costs for the SR.N5 are approximately £2 to £3 less than in the case of the SR.N6.

BUDGETARY COSTS - CIVIL CRAFT

SR.N4

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	Pence	U.S. Cents	Local	Pence	U.S. Cents	Local
(a) D.O.C. per passenger n.m (all passenger version) 100% load factor 50 knots block speed	2.4	2.8		2.1	2.4	
(b) D.O.C. per passenger (car ferry role)	4.4	5.1		3.8	4.4	
(c) D.O.C. per car (car ferry role)	12	14		10	12	

BUDGETARY COSTS - CIVIL CRAFT

4. General Notes

(i) Ground Equipment, Special Tools and Spare Parts

Cost estimates given for the ground equipment, special tools and spare parts exclude engine items and proprietary items, e.g. radio.

The spares allowance should cover between 1000 and 2000 hours operation, but a number of major 'insurance' items should be unused at the end of this period.

Bristol Siddeley Engines Limited offer a guaranteed "power by the hour" system of paying for engine overhauls and replacements. Details of this can be obtained from:-

The Commercial Manager,
Bristol Siddeley Engines Ltd.,
P.O. Box 17,
Ansty,
Coventry,
Warickshire.

(ii) Training of Commanders and Engineers

The British Hovercraft Corporation (B.H.C.) offer the following instructions free of charge.

Commanders	10 hours for a Commander for each craft purchased.
Engineers	A 4 week course at the B.H.C. factory at Cowes, Isle of Wight, for each of two engineers per craft purchased. In addition B.H.C. will arrange for engine courses (free of charge) at the Bristol factory.

All costs of travel and of lodging and subsistence in England, will be the responsibility of the purchaser.

B.H.C. will provide a Service Engineer in the country of the purchaser to assist in starting the Hovercraft Service, for an initial period of up to 60 days.

The cost of air travel of the Service Engineer and of his lodging and subsistence in the country of the purchaser, will be the responsibility of the purchaser.

BRITISH HOVERCRAFT CORPORATION LIMITED

STANDARD CONDITIONS OF SALE

1. GENERAL

The acceptance of any quotation by British Hovercraft Corporation Limited (hereinafter called B.H.C.) or of any goods supplied advice given or service rendered by B.H.C. includes the acceptance of these Standard Conditions and no variation of or addition to the same shall be admissible unless expressly agreed in writing by B.H.C. and signed by B.H.C.

2. DESCRIPTION

The description and illustrations in catalogues, price lists and other leaflets or descriptive matter are intended merely to present a general idea of the goods described therein and none of these shall form part of the contract and no report, representation or statement made by any representative of B.H.C. not contained herein, shall be binding to B.H.C.

3. DELIVERY

B.H.C. will use its best endeavours to complete delivery of the goods in the period stated but accepts no liability in damage or otherwise for failure to do so from any cause whatsoever including but without prejudice to the generality of the foregoing words war civil commotion fire flood accident labour dispute shortage of materials Act of Government or other authority or any other cause or causes (whether similar or not) beyond the reasonable control of B.H.C. Delays howsoever caused shall not be a ground for cancellation.

4. PACKING

Packing is not included in the price and all packages will be charged for extra but the charge will be credited in full if packing is returned to B.H.C. at its works whose address is indicated on the Despatch Note, carriage paid in good condition within three months of date of despatch by B.H.C. Whilst every care is taken in packing B.H.C. do not undertake any responsibility for damage to packing or goods during transit except as mentioned below.

5. TRANSIT

Claims for damage in transit or shortage in delivery of the goods will only be considered if the carriers and B.H.C. receive written notification of such damage within three days of delivery or in the event of loss of goods in transit within 21 days of the date of consignment. When goods are accepted from British Railways or carriers without being checked the delivery book must be signed "Not examined".

6. PAYMENT

When not otherwise stated payment shall be net cash in the calendar month following the month of delivery and shall be in pounds sterling.

7. PRICE

Any prices quoted are ex B.H.C. Works and are based on the cost of material rates and wages payable to labour and of conforming to statutory obligations ruling at the date hereof and if between the date hereof and the date of delivery variations either by rise or fall occur in these costs the prices shall be amended to provide for such variations and any additional sum payable to B.H.C. by the Purchaser in respect of same shall be paid in cash sterling. The Purchaser shall pay all transport, insurance, and where applicable any taxes, licence fees, customs, import and export duties and charges.

8. INSPECTION-ACCEPTANCE

The goods the subject of this contract shall be manufactured and released in accordance with the relevant requirements of the Air Registration Board or any public Authority or Authorities in the United Kingdom to whose jurisdiction control or regulations Air Cushion Vehicles may from time to time be or become subject and in addition such of the details as are manufactured by B.H.C. shall be inspected and released by B.H.C. under its own system of inspection as approved by the said Air Registration Board or any public Authority or Authorities in the United Kingdom to whose jurisdiction control or regulations Air Cushion Vehicles may from time to time be or become subject and such inspection and release shall constitute acceptance of all the goods.

9. WARRANTY

(i) If in any Air Cushion Vehicle, Air Cushion Vehicle components or spares before the completion of 200 hours of use or six calendar months from the date of delivery (whichever period shall first expire) any defect shall appear which arises solely from faulty materials or workmanship, B.H.C. hereby warrants on the return of the part or parts alleged to be defective carriage paid to such of its works as it may direct to make good such defect either by repair or at B.H.C. option by replacement provided that B.H.C. shall be under no liability under this sub-clause if the Air Cushion Vehicle or component part alleged to be defective has been subject to any abnormal conditions or to misuse or neglect or has been involved in any accident or has not been maintained in accordance with proper standards.

(ii) In the case of defects in engines instruments accessories or parts not manufactured by B.H.C. in place of the Purchaser's right set out in sub-clause (i) of this clause the Purchaser will be entitled only to receive the benefit from B.H.C. of all benefits received by B.H.C. under any guarantee or warranty by the supplier to B.H.C.

(iii) The warranty set out in sub-clauses (i) and (ii) of this clause is expressly limited to the despatch to the Purchaser without charge except for carriage and customs or other duties of a new or repaired part and does not include the cost of inspection and any dismantling or re-erection.

(iv) The express warranty contained in this clause is accepted by the Purchaser in place of any warranty condition or liability express or implied by law or otherwise either in contract or in tort or otherwise in respect of any defect in or failure of any Air Cushion Vehicle or component part of any Air Cushion Vehicle or of any spare or replacement parts or ancillary equipment or for any injury loss or damage directly or indirectly attributable to such defect or failure.

(v) Except as expressly provided in this clause B.H.C. will not be liable in contract or in tort or otherwise for any loss or damage sustained by reason of anything done or omitted whether by reason of the negligence of any person or otherwise, whether in advising in regard to or inspecting or supplying any Air Cushion Vehicle or spares or components for Air Cushion Vehicles or their selection fitting supply use repair or modification or in training commanders or engineers or the course of services rendered by B.H.C. engineers. All spare parts or components supplied or advice given or services rendered or training carried out are deemed to be supplied given rendered or carried out on the terms of this clause unless otherwise agreed in writing and signed by B.H.C. The Purchaser agrees to indemnify B.H.C. against all claims against B.H.C. made by persons in the employment of the Purchaser liability for which would have been excluded by this clause if such claims had been made by the Purchaser.

(vi) In the event of a claim being made by the Purchaser or any person in the employment of the Purchaser against any servant of B.H.C. liability for which would have been excluded by this clause if such claim had been made by the Purchaser against B.H.C., B.H.C. shall be entitled to indemnify such servant in respect of such claim and the Purchaser will indemnify B.H.C. in respect of such indemnity.

10. FRUSTRATION

If this contract or any part of it shall become impossible of performance or otherwise frustrated B.H.C. shall be entitled to a fair and reasonable proportion

of the price in respect of the work done up to the date thereof and for this purpose any moneys previously paid by the Purchaser shall be retained by B.H.C. as against the sum due to B.H.C. under this provision, any balance to be repaid to the Purchaser or as the case may be any deficiency to be paid to B.H.C. by the Purchaser. B.H.C. may dispose of the goods as they may think fit, due allowance being made to the Purchaser for the net proceeds thereof.

11. PATENTS

If any goods to be supplied by B.H.C. are to be in accordance with the Purchaser's specification or instructions the Purchaser shall indemnify B.H.C. against all damages, penalties, costs and expenses to which B.H.C. may become liable or which it may incur through complying with any such specifications or instructions, involving an infringement of Patent, Registered Design or Trade Mark.

12. LEGAL INTERPRETATION

The contract will be deemed to be made in England and shall be governed and construed for all purposes and in all respects in accordance with English Law.

CONDITION PARAMOUNT

Condition 9 above is deemed to be incorporated in all contracts made between B.H.C. and the Purchaser, and all other conditions or clauses which may be inconsistent therewith shall be treated as void to the extent of such inconsistency.

Pam: 629.1.039
c.2

BHC

BUDGETARY COSTS
for
CIVIL AIR CUSHION VEHICLES

SR.N5

SR.N6

SR.N4

BROCHURE B.385
JANUARY 1967

POLAR
PAM
4646

POLARPAM

BRITISH HOVERCRAFT CORPORATION LTD., YEOVIL, ENGLAND.

THE BOREAL INSTITUTE
LIBRARY
NOV 6 1967

CONTENTS

Section No. Description Page No.

1. Introduction 1

2. Initial Costs

(a) SR.N5 2
(b) SR.N6 4
(c) SR.N4 6

3. Direct Operating Costs

(a) SR.N6 8
(b) SR.N4 10

4. General Notes 12

5. Conditions of Sale 13

BUDGETARY COSTS - CIVIL CRAFT

1. INTRODUCTION

1. In this brochure, price indications are given for the range of Air Cushion Vehicles now in production at the factories of the British Hovercraft Corporation.

2. All prices given are approximations, given for Budgetary purposes and are subject to revision by formal quotations which will be provided on request.

3. All sales are subject to the company's Standard Conditions of Sale, details of which are given on Page 11.

4. Initial costs are given for the sale of one A.C.V. of each type. If two or more craft are ordered, the cost of ground equipment, special tools and spare parts will be considerably less per craft purchased than in the case of the purchase of a single craft.

5. The equivalent costs given in U.S $ are based on an exchange rate of 2.8 U.S $ to the £ sterling. When the current rate differs, adjustment should be made accordingly.

6. Details are also given of Direct Operating Costs. These are approximations only, and may be more, or less, depending upon the following factors:

    (i) Number of craft being operated
    (ii) Type of route
    (iii) Experience of operating and maintenance crews
    (iv) Local rates of salaries
    (v) Local fuel costs
    (vi) Period of time craft have been operating on the service. As a general rule, operating costs may be expected to be reduced after the craft have been in service with an Operator for one or two years.

BUDGETARY COSTS - CIVIL CRAFT

2. Initial Costs

(A) SR.N5

		Approximate Cost		
Item No.	Item	£ Sterling	U.S. $	Local currency
1.	One SR.N5 A.C.V. fitted with standard specification equipment	88,700	248,360	
2.	One set of Operational equipment as detailed on Page 3	12,880	36,064	
3.	Ground Equipment, Special Tools and Spare Parts (i) Ground equipment (ii) Special Tools (iii) Spare Parts	15,000	42,000	
	Total cost of one SR.N5 A.C.V. complete with operational equipment, ground equipment special tools and spare parts.	116,580	326,424	

Alternative Methods of Payment Available

(i) Direct Sale

25% deposit on signature of contract

Balance on delivery of goods

Note: A small discount is available on prices quoted in paragraph 1 above, for a direct sale.

(ii) Payment over 5 year period

Interest charges are added to prices given in paragraph 1 above.

20 % of initial value of order deposited on signature of contract.

Balance payable in ten 6 monthly payments, the first of which is payable six months after delivery of craft.

SR.N5

List of Operational Equipment

Item	Description
1.	Interior cabin sound proofing and trim excluding seats
2.	Fixed seats for 18 passengers complete with ashtrays
3.	Redifon radio type GR.289 Mk.2 complete with 2 head sets
4.	Air Conditioning System (no heating)
5.	Complete Kelvin Hughes Radar Installation including :- Kelvin Hughes Radar Installation Radar Operator Station Blackout partition Gyro Compass Rate of turn indicator
6.	Installation of safety glass window wiping and washing on port side
7.	Magnasyn compass installation
8.	One 21 seat dinghy
9.	19 Life jackets
10.	Signal pistol and stowage
11.	Aldis signalling lamp and stowage
12.	First aid box and stowage
13.	Fire Axes (2)

TOTAL - One set of Operational Equipment - £12,880

U.S. $ - 36,064

BUDGETARY COSTS - CIVIL CRAFT

(B) SR.N6

		Approximate Cost		
Item No.	**Item**	**£ Sterling**	**U.S. $**	**Local Currency**
1.	One SR.N6 A.C.V. fitted with standard specification equipment	114,500	320,600	
2.	One set of operational equipment as detailed on page 5	14,650	41,020	
3.	Ground Equipment, Special Tools and Spare Parts			
	(i) Ground equipment	6,250	17,500	
	(ii) Special tools	550	1,540	
	(iii) Spare Parts	9,100	25,480	
	Total cost of one SR.N6 A.C.V. complete with operational equipment, ground equipment special tools and spare parts	145,050	406,140	

Alternative Methods of Payment Available

(i) Direct Sale

25% Deposit on signature of contract

Balance on delivery of goods

Note: A small discount available on prices quoted in Paragraph 1 above, for a direct sale.

(ii) Payment over 5 year period

Interest charges are added to prices given in Paragraph 1. above.

20% of initial value of order deposited on signature of contract.

Balance payable in ten 6 monthly payments, the first of which is payable six months after delivery of craft.

SR.N6

List of Operational Equipment

Item	Description
1.	Interior cabin sound proofing and trim excluding seats
2.	Fixed seats for 38 passengers complete with ashtrays
3.	Redifon radio type GR 289 Mk.2 complete with 2 head sets
4.	Air conditioning system (no heating)
5.	Complete Kelvin Hughes Radar Installation including :- Kelvin Hughes Radar Installation Radar Operator Station Black out partition Gyro compass Rate of turn indicator
6.	Installation of safety glass window wiping and washing on port side, Modification N6/100
7.	Magnasyn compass installation
8.	Two 21 seat dinghies
9.	41 Life jackets
10.	Signal pistol and stowage
11.	Aldis signalling lamp and stowage
12.	First aid box and stowage
13.	Fire axes (2)

TOTAL - one set of operational equipment - £14,650

U.S. $ - 41,020

BUDGETARY COSTS - CIVIL CRAFT

(C) SR.N4

Item No.	Item	Approximate Cost £ Sterling	U.S. $	Local Currency
1.	One SR.N4 A.C.V. equipped with normal operational equipment for car ferry role, including : seats, radio, navigational aids including radar night operational equipment, safety equipment	1,638,000	4,586,400	
2.	Ground equipment, special tools and spare parts, including one spare Proteus engine	225,000	630,000	
	Total cost of one SR.N4 A.C.V. complete with operational equipment, ground equipment and spare parts	1,863,000	5,216,400	

Alternative methods of payment available

(i) Direct Sale

25% Deposit on signature of contract

Balance on delivery of goods

Note: A small discount available on prices quoted in paragraph 1. above, for a direct sale.

(ii) Payment over 7 year period

Interest charges are added to prices given in Paragraph 1. above.

10% deposit on signature of contract.

BUDGETARY COSTS - CIVIL CRAFT

A further 10% deposit 12 months after signature of contract.

Balance payable in fourteen 6 monthly payments the first of which is payable 6 months after delivery of craft.

BUDGETARY COSTS - CIVIL CRAFT

(A) SR.N6

3. Direct Operating Costs (per hour)
(D.O.C.)

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	£ Sterling	U.S $	Local	£ Sterling	U.S. $	Local
Depreciation (7 years with 25% residual value)	10.4	29		7.8	22	
Interest (5% of mean value)	3	8.4		2.3	6.4	
Insurance (2½% of initial value) (including 3rd party but not passenger)	2.1	5.9		1.6	4.5	
Crew (Commander and one Crewman)	3.7	10.3		4.5	12.6	
Fuel and Oil (at 15d or 17 cents per Imp.gallon)	4	11.2		4	11.2	
Maintenance Costs						
Engine	9	25		9	25	
Skirt	4	11.2		4	11.2	
Transmission	1.8	5.1		1.8	5.1	
Propeller	2	5.6		2	5.6	
Structure	1	2.8		1	2.8	
Labour	2	5.6		2	5.6	
TOTAL	43	120		40	112	

BUDGETARY COSTS - CIVIL CRAFT

	ANNUAL UTILISATION					
	1500 hrs			2000 hrs		
	Approximate cost					
	Pence	U.S. Cents	Local	Pence	U.S.Cents	Local
D.O.C. per passenger n.m (100% load factor. 40 knots block speed 38 passenger capacity)	6.8	7.9		6.3	7.4	

Note: The hourly Direct Operating Costs for the SR.N5 are approximately £2 to £3 less than in the case of the SR.N6.

BUDGETARY COSTS - CIVIL CRAFT

(B) SR.N4

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	£ Sterling	U.S. $	Local	£ Sterling	U.S. $.	Local
Depreciation (10 years with residual value of 15%)	105	294		79	221	
Interest (5% of mean value)	36	101		27	76	
Insurance (2½% of initial value) (including 3rd party but not passenger)	28	78		21	59	
Crew (Commander, Navigator and third crewman)	10	28		10	28	
Fuel and Oil (at 15d or 17 cents per Imp.gallon)	50	140		50	140	
Maintenance costs						
Engine	20	56		20	56	
Skirt	20	56		20	56	
Transmission	8	22		8	22	
Propeller	8	22		8	22	
Structure	12	34		12	34	
Labour	10	28		10	28	
TOTAL	307	859		265	742	

BUDGETARY COSTS - CIVIL CRAFT

SR.N4

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	Pence	U.S. Cents	Local	Pence	U.S. Cents	Local
(a) D.O.C. per passenger n.m (all passenger version) 100% load factor 50 knots block speed	2.4	2.8		2.1	2.4	
(b) D.O.C. per passenger (car ferry role)	4.4	5.1		3.8	4.4	
(c) D.O.C. per car (car ferry role)	12	14		10	12	

BUDGETARY COSTS - CIVIL CRAFT

4. General Notes

(i) Ground Equipment, Special Tools and Spare Parts

Cost estimates given for the ground equipment, special tools and spare parts exclude engine items and proprietary items, e.g. radio.

The spares allowance should cover between 1000 and 2000 hours operation, but a number of major 'insurance' items should be unused at the end of this period.

Bristol Siddeley Engines Limited offer a guaranteed "power by the hour" system of paying for engine overhauls and replacements. Details of this can be obtained from:-

The Commercial Manager,
Bristol Siddeley Engines Ltd.,
P.O. Box 17,
Ansty,
Coventry,
Warickshire.

(ii) Training of Commanders and Engineers

The British Hovercraft Corporation (B.H.C.) offer the following instructions free of charge.

Commanders	10 hours for a Commander for each craft purchased.
Engineers	A 4 week course at the B.H.C. factory at Cowes, Isle of Wight, for each of two engineers per craft purchased. In addition B.H.C. will arrange for engine courses (free of charge) at the Bristol factory.

All costs of travel and of lodging and subsistence in England, will be the responsibility of the purchaser.

B.H.C. will provide a Service Engineer in the country of the purchaser to assist in starting the Hovercraft Service, for an initial period of up to 60 days.

The cost of air travel of the Service Engineer and of his lodging and subsistence in the country of the purchaser, will be the responsibility of the purchaser.

BRITISH HOVERCRAFT CORPORATION LIMITED

STANDARD CONDITIONS OF SALE

1. GENERAL

The acceptance of any quotation by British Hovercraft Corporation Limited (hereinafter called B.H.C.) or of any goods supplied advice given or service rendered by B.H.C. includes the acceptance of these Standard Conditions and no variation of or addition to the same shall be admissible unless expressly agreed in writing by B.H.C. and signed by B.H.C.

2. DESCRIPTION

The description and illustrations in catalogues, price lists and other leaflets or descriptive matter are intended merely to present a general idea of the goods described therein and none of these shall form part of the contract and no report, representation or statement made by any representative of B.H.C. not contained herein, shall be binding to B.H.C.

3. DELIVERY

B.H.C. will use its best endeavours to complete delivery of the goods in the period stated but accepts no liability in damage or otherwise for failure to do so from any cause whatsoever including but without prejudice to the generality of the foregoing words war civil commotion fire flood accident labour dispute shortage of materials Act of Government or other authority or any other cause or causes (whether similar or not) beyond the reasonable control of B.H.C. Delays howsoever caused shall not be a ground for cancellation.

4. PACKING

Packing is not included in the price and all packages will be charged for extra but the charge will be credited in full if packing is returned to B.H.C. at its works whose address is indicated on the Despatch Note, carriage paid in good condition within three months of date of despatch by B.H.C. Whilst every care is taken in packing B.H.C. do not undertake any responsibility for damage to packing or goods during transit except as mentioned below.

5. TRANSIT

Claims for damage in transit or shortage in delivery of the goods will only be considered if the carriers and B.H.C. receive written notification of such damage within three days of delivery or in the event of loss of goods in transit within 21 days of the date of consignment. When goods are accepted from British Railways or carriers without being checked the delivery book must be signed "Not examined".

6. PAYMENT

When not otherwise stated payment shall be net cash in the calendar month following the month of delivery and shall be in pounds sterling.

7. PRICE

Any prices quoted are ex B.H.C. Works and are based on the cost of material rates and wages payable to labour and of conforming to statutory obligations ruling at the date hereof and if between the date hereof and the date of delivery variations either by rise or fall occur in these costs the prices shall be amended to provide for such variations and any additional sum payable to B.H.C. by the Purchaser in respect of same shall be paid in cash sterling. The Purchaser shall pay all transport, insurance, and where applicable any taxes, licence fees, customs, import and export duties and charges.

8. INSPECTION-ACCEPTANCE

The goods the subject of this contract shall be manufactured and released in accordance with the relevant requirements of the Air Registration Board or any public Authority or Authorities in the United Kingdom to whose jurisdiction control or regulations Air Cushion Vehicles may from time to time be or become subject and in addition such of the details as are manufactured by B.H.C. shall be inspected and released by B.H.C. under its own system of inspection as approved by the said Air Registration Board or any public Authority or Authorities in the United Kingdom to whose jurisdiction control or regulations Air Cushion Vehicles may from time to time be or become subject and such inspection and release shall constitute acceptance of all the goods.

9. WARRANTY

(i) If in any Air Cushion Vehicle, Air Cushion Vehicle components or spares before the completion of 200 hours of use or six calendar months from the date of delivery (whichever period shall first expire) any defect shall appear which arises solely from faulty materials or workmanship, B.H.C. hereby warrants on the return of the part or parts alleged to be defective carriage paid to such of its works as it may direct to make good such defect either by repair or at B.H.C. option by replacement provided that B.H.C. shall be under no liability under this sub-clause if the Air Cushion Vehicle or component part alleged to be defective has been subject to any abnormal conditions or to misuse or neglect or has been involved in any accident or has not been maintained in accordance with proper standards.

(ii) In the case of defects in engines instruments accessories or parts not manufactured by B.H.C. in place of the Purchaser's right set out in sub-clause (i) of this clause the Purchaser will be entitled only to receive the benefit from B.H.C. of all benefits received by B.H.C. under any guarantee or warranty by the supplier to B.H.C.

(iii) The warranty set out in sub-clauses (i) and (ii) of this clause is expressly limited to the despatch to the Purchaser without charge except for carriage and customs or other duties of a new or repaired part and does not include the cost of inspection and any dismantling or re-erection.

(iv) The express warranty contained in this clause is accepted by the Purchaser in place of any warranty condition or liability express or implied by law or otherwise either in contract or in tort or otherwise in respect of any defect in or failure of any Air Cushion Vehicle or component part of any Air Cushion Vehicle or of any spare or replacement parts or ancillary equipment or for any injury loss or damage directly or indirectly attributable to such defect or failure.

(v) Except as expressly provided in this clause B.H.C. will not be liable in contract or in tort or otherwise for any loss or damage sustained by reason of anything done or omitted whether by reason of the negligence of any person or otherwise, whether in advising in regard to or inspecting or supplying any Air Cushion Vehicle or spares or components for Air Cushion Vehicles or their selection fitting supply use repair or modification or in training commanders or engineers or the course of services rendered by B.H.C. engineers. All spare parts or components supplied or advice given or services rendered or training carried out are deemed to be supplied given rendered or carried out on the terms of this clause unless otherwise agreed in writing and signed by B.H.C. The Purchaser agrees to indemnify B.H.C. against all claims against B.H.C. made by persons in the employment of the Purchaser liability for which would have been excluded by this clause if such claims had been made by the Purchaser.

(vi) In the event of a claim being made by the Purchaser or any person in the employment of the Purchaser against any servant of B.H.C. liability for which would have been excluded by this clause if such claim had been made by the Purchaser against B.H.C., B.H.C. shall be entitled to indemnify such servant in respect of such claim and the Purchaser will indemnify B.H.C. in respect of such indemnity.

10. FRUSTRATION

If this contract or any part of it shall become impossible of performance or otherwise frustrated B.H.C. shall be entitled to a fair and reasonable proportion

of the price in respect of the work done up to the date thereof and for this purpose any moneys previously paid by the Purchaser shall be retained by B.H.C. as against the sum due to B.H.C. under this provision, any balance to be repaid to the Purchaser or as the case may be any deficiency to be paid to B.H.C. by the Purchaser. B.H.C. may dispose of the goods as they may think fit, due allowance being made to the Purchaser for the net proceeds thereof.

11. PATENTS

If any goods to be supplied by B.H.C. are to be in accordance with the Purchaser's specification or instructions the Purchaser shall indemnify B.H.C. against all damages, penalties, costs and expenses to which B.H.C. may become liable or which it may incur through complying with any such specifications or instructions, involving an infringement of Patent, Registered Design or Trade Mark.

12. LEGAL INTERPRETATION

The contract will be deemed to be made in England and shall be governed and construed for all purposes and in all respects in accordance with English Law.

CONDITION PARAMOUNT

Condition 9 above is deemed to be incorporated in all contracts made between B.H.C. and the Purchaser, and all other conditions or clauses which may be inconsistent therewith shall be treated as void to the extent of such inconsistency.

B.H.C. L.28 SRN 5, 6, 4,
c.1.

TAM. 629.1.039.

BHC

BUDGETARY COSTS
for
CIVIL AIR CUSHION VEHICLES

SR.N5

SR.N6

SR.N4

BROCHURE B.385
JANUARY 1967

BRITISH HOVERCRAFT CORPORATION LTD., YEOVIL, ENGLAND.

POLAR
PAM
4646

POLARPAM

THE BOREAL INSTITUTE
LIBRARY

NOV 6 1967

CONTENTS

Section No.	Description	Page No.
1.	Introduction	1
2.	Initial Costs	
	(a) SR.N5	2
	(b) SR.N6	4
	(c) SR.N4	6
3.	Direct Operating Costs	
	(a) SR.N6	8
	(b) SR.N4	10
4.	General Notes	12
5.	Conditions of Sale	13

BUDGETARY COSTS - CIVIL CRAFT

1. INTRODUCTION

1. In this brochure, price indications are given for the range of Air Cushion Vehicles now in production at the factories of the British Hovercraft Corporation.

2. All prices given are approximations, given for Budgetary purposes and are subject to revision by formal quotations which will be provided on request.

3. All sales are subject to the company's Standard Conditions of Sale, details of which are given on Page 11.

4. Initial costs are given for the sale of one A.C.V. of each type. If two or more craft are ordered, the cost of ground equipment, special tools and spare parts will be considerably less per craft purchased than in the case of the purchase of a single craft.

5. The equivalent costs given in U.S $ are based on an exchange rate of 2.8 U.S $ to the £ sterling. When the current rate differs, adjustment should be made accordingly.

6. Details are also given of Direct Operating Costs. These are approximations only, and may be more, or less, depending upon the following factors:

   (i) Number of craft being operated
   (ii) Type of route
   (iii) Experience of operating and maintenance crews
   (iv) Local rates of salaries
   (v) Local fuel costs
   (vi) Period of time craft have been operating on the service. As a general rule, operating costs may be expected to be reduced after the craft have been in service with an Operator for one or two years.

BUDGETARY COSTS - CIVIL CRAFT

2. **Initial Costs**

(A) SR.N5

		Approximate Cost		
Item No.	Item	£ Sterling	U.S. $	Local currency
1.	One SR.N5 A.C.V. fitted with standard specification equipment	88,700	248,360	
2.	One set of Operational equipment as detailed on Page 3	12,880	36,064	
3.	Ground Equipment, Special Tools and Spare Parts (i) Ground equipment (ii) Special Tools (iii) Spare Parts	15,000	42,000	
	Total cost of one SR.N5 A.C.V. complete with operational equipment, ground equipment special tools and spare parts.	116,580	326,424	

Alternative Methods of Payment Available

(i) **Direct Sale**

25% deposit on signature of contract

Balance on delivery of goods

Note: A small discount is available on prices quoted in paragraph 1 above, for a direct sale.

(ii) **Payment over 5 year period**

Interest charges are added to prices given in paragraph 1 above.

20 % of initial value of order deposited on signature of contract.

Balance payable in ten 6 monthly payments, the first of which is payable six months after delivery of craft.

SR.N5

List of Operational Equipment

Item	Description
1.	Interior cabin sound proofing and trim excluding seats
2.	Fixed seats for 18 passengers complete with ashtrays
3.	Redifon radio type GR.289 Mk.2 complete with 2 head sets
4.	Air Conditioning System (no heating)
5.	Complete Kelvin Hughes Radar Installation including :- Kelvin Hughes Radar Installation Radar Operator Station Blackout partition Gyro Compass Rate of turn indicator
6.	Installation of safety glass window wiping and washing on port side
7.	Magnasyn compass installation
8.	One 21 seat dinghy
9.	19 Life jackets
10.	Signal pistol and stowage
11.	Aldis signalling lamp and stowage
12.	First aid box and stowage
13.	Fire Axes (2)

TOTAL - One set of Operational Equipment - £12,880

U.S. $ - 36,064

BUDGETARY COSTS - CIVIL CRAFT

(B) SR.N6

Item No.	Item	Approximate Cost £ Sterling	 U.S. $	 Local Currency
1.	One SR.N6 A.C.V. fitted with standard specification equipment	114,500	320,600	
2.	One set of operational equipment as detailed on page 5	14,650	41,020	
3.	**Ground Equipment, Special Tools and Spare Parts**			
	(i) Ground equipment	6,250	17,500	
	(ii) Special tools	550	1,540	
	(iii) Spare Parts	9,100	25,480	
	Total cost of one SR.N6 A.C.V. complete with operational equipment, ground equipment special tools and spare parts	145,050	406,140	

Alternative Methods of Payment Available

(i) **Direct Sale**

25% Deposit on signature of contract

Balance on delivery of goods

Note: A small discount available on prices quoted in Paragraph 1 above, for a direct sale.

(ii) **Payment over 5 year period**

Interest charges are added to prices given in Paragraph 1. above.

20% of initial value of order deposited on signature of contract.

Balance payable in ten 6 monthly payments, the first of which is payable six months after delivery of craft.

SR.N6

List of Operational Equipment

Item	Description
1.	Interior cabin sound proofing and trim excluding seats
2.	Fixed seats for 38 passengers complete with ashtrays
3.	Redifon radio type GR 289 Mk.2 complete with 2 head sets
4.	Air conditioning system (no heating)
5.	Complete Kelvin Hughes Radar Installation including :- Kelvin Hughes Radar Installation Radar Operator Station Black out partition Gyro compass Rate of turn indicator
6.	Installation of safety glass window wiping and washing on port side, Modification N6/100
7.	Magnasyn compass installation
8.	Two 21 seat dinghies
9.	41 Life jackets
10.	Signal pistol and stowage
11.	Aldis signalling lamp and stowage
12.	First aid box and stowage
13.	Fire axes (2)

TOTAL - one set of operational equipment - £14,650

U.S. $ - 41,020

BUDGETARY COSTS - CIVIL CRAFT

(C) SR.N4

		Approximate Cost		
Item No.	Item	£ Sterling	U.S. $	Local Currency
1.	One SR.N4 A.C.V. equipped with normal operational equipment for car ferry role, including : seats, radio, navigational aids including radar night operational equipment, safety equipment	1,638,000	4,586,400	
2.	Ground equipment, special tools and spare parts, including one spare Proteus engine	225,000	630,000	
	Total cost of one SR.N4 A.C.V. complete with operational equipment, ground equipment and spare parts	1,863,000	5,216,400	

Alternative methods of payment available

(i) Direct Sale

25% Deposit on signature of contract

Balance on delivery of goods

Note: A small discount available on prices quoted in paragraph 1. above, for a direct sale.

(ii) Payment over 7 year period

Interest charges are added to prices given in Paragraph 1. above.

10% deposit on signature of contract.

BUDGETARY COSTS - CIVIL CRAFT

A further 10% deposit 12 months after signature of contract.

Balance payable in fourteen 6 monthly payments the first of which is payable 6 months after delivery of craft.

BUDGETARY COSTS - CIVIL CRAFT

(A) SR.N6

3. Direct Operating Costs (per hour)
(D.O.C.)

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	£ Sterling	U.S $	Local	£ Sterling	U.S. $	Local
Depreciation (7 years with 25% residual value)	10.4	29		7.8	22	
Interest (5% of mean value)	3	8.4		2.3	6.4	
Insurance (2½% of initial value) (including 3rd party but not passenger)	2.1	5.9		1.6	4.5	
Crew (Commander and one Crewman)	3.7	10.3		4.5	12.6	
Fuel and Oil (at 15d or 17 cents per Imp.gallon)	4	11.2		4	11.2	
Maintenance Costs						
Engine	9	25		9	25	
Skirt	4	11.2		4	11.2	
Transmission	1.8	5.1		1.8	5.1	
Propeller	2	5.6		2	5.6	
Structure	1	2.8		1	2.8	
Labour	2	5.6		2	5.6	
TOTAL	43	120		40	112	

BUDGETARY COSTS - CIVIL CRAFT

	ANNUAL UTILISATION					
	1500 hrs			2000 hrs		
	Approximate cost					
	Pence	U.S. Cents	Local	Pence	U.S.Cents	Local
D.O.C. per passenger n.m (100% load factor. 40 knots block speed 38 passenger capacity)	6.8	7.9		6.3	7.4	

Note: The hourly Direct Operating Costs for the SR.N5 are approximately £2 to £3 less than in the case of the SR.N6.

BUDGETARY COSTS - CIVIL CRAFT

(B) SR.N4

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	£ Sterling	U.S. $	Local	£ Sterling	U.S. $.	Local
Depreciation (10 years with residual value of 15%)	105	294		79	221	
Interest (5% of mean value)	36	101		27	76	
Insurance (2½% of initial value) (including 3rd party but not passenger)	28	78		21	59	
Crew (Commander, Navigator and third crewman)	10	28		10	28	
Fuel and Oil (at 15d or 17 cents per Imp.gallon)	50	140		50	140	
Maintenance costs						
Engine	20	56		20	56	
Skirt	20	56		20	56	
Transmission	8	22		8	22	
Propeller	8	22		8	22	
Structure	12	34		12	34	
Labour	10	28		10	28	
TOTAL	307	859		265	742	

BUDGETARY COSTS - CIVIL CRAFT

SR.N4

	Annual Utilisation					
	1500 hrs			2000 hrs		
	Approx. Cost					
	Pence	U.S. Cents	Local	Pence	U.S. Cents	Local
(a) D.O.C. per passenger n.m (all passenger version) 100% load factor 50 knots block speed	2.4	2.8		2.1	2.4	
(b) D.O.C. per passenger (car ferry role)	4.4	5.1		3.8	4.4	
(c) D.O.C. per car (car ferry role)	12	14		10	12	

BUDGETARY COSTS - CIVIL CRAFT

General Notes

(i) Ground Equipment, Special Tools and Spare Parts

Cost estimates given for the ground equipment, special tools and spare parts exclude engine items and proprietary items, e.g. radio.

The spares allowance should cover between 1000 and 2000 hours operation, but a number of major 'insurance' items should be unused at the end of this period.

Bristol Siddeley Engines Limited offer a guaranteed "power by the hour" system of paying for engine overhauls and replacements. Details of this can be obtained from:-

The Commercial Manager,
Bristol Siddeley Engines Ltd.,
P.O. Box 17,
Ansty,
Coventry,
Warickshire.

(ii) Training of Commanders and Engineers

The British Hovercraft Corporation (B.H.C.) offer the following instructions free of charge.

Commanders	10 hours for a Commander for each craft purchased.
Engineers	A 4 week course at the B.H.C. factory at Cowes, Isle of Wight, for each of two engineers per craft purchased. In addition B.H.C. will arrange for engine courses (free of charge) at the Bristol factory.

All costs of travel and of lodging and subsistence in England, will be the responsibility of the purchaser.

B.H.C. will provide a Service Engineer in the country of the purchaser to assist in starting the Hovercraft Service, for an initial period of up to 60 days.

The cost of air travel of the Service Engineer and of his lodging and subsistence in the country of the purchaser, will be the responsibility of the purchaser.

BRITISH HOVERCRAFT CORPORATION LIMITED

STANDARD CONDITIONS OF SALE

1. GENERAL

The acceptance of any quotation by British Hovercraft Corporation Limited (hereinafter called B.H.C.) or of any goods supplied advice given or service rendered by B.H.C. includes the acceptance of these Standard Conditions and no variation of or addition to the same shall be admissible unless expressly agreed in writing by B.H.C. and signed by B.H.C.

2. DESCRIPTION

The description and illustrations in catalogues, price lists and other leaflets or descriptive matter are intended merely to present a general idea of the goods described therein and none of these shall form part of the contract and no report, representation or statement made by any representative of B.H.C. not contained herein, shall be binding to B.H.C.

3. DELIVERY

B.H.C. will use its best endeavours to complete delivery of the goods in the period stated but accepts no liability in damage or otherwise for failure to do so from any cause whatsoever including but without prejudice to the generality of the foregoing words war civil commotion fire flood accident labour dispute shortage of materials Act of Government or other authority or any other cause or causes (whether similar or not) beyond the reasonable control of B.H.C. Delays howsoever caused shall not be a ground for cancellation.

4. PACKING

Packing is not included in the price and all packages will be charged for extra but the charge will be credited in full if packing is returned to B.H.C. at its works whose address is indicated on the Despatch Note, carriage paid in good condition within three months of date of despatch by B.H.C. Whilst every care is taken in packing B.H.C. do not undertake any responsibility for damage to packing or goods during transit except as mentioned below.

5. TRANSIT

Claims for damage in transit or shortage in delivery of the goods will only be considered if the carriers and B.H.C. receive written notification of such damage within three days of delivery or in the event of loss of goods in transit within 21 days of the date of consignment. When goods are accepted from British Railways or carriers without being checked the delivery book must be signed "Not examined".

6. PAYMENT

When not otherwise stated payment shall be net cash in the calendar month following the month of delivery and shall be in pounds sterling.

7. PRICE

Any prices quoted are ex B.H.C. Works and are based on the cost of material rates and wages payable to labour and of conforming to statutory obligations ruling at the date hereof and if between the date hereof and the date of delivery variations either by rise or fall occur in these costs the prices shall be amended to provide for such variations and any additional sum payable to B.H.C. by the Purchaser in respect of same shall be paid in cash sterling. The Purchaser shall pay all transport, insurance, and where applicable any taxes, licence fees, customs, import and export duties and charges.

8. INSPECTION-ACCEPTANCE

The goods the subject of this contract shall be manufactured and released in accordance with the relevant requirements of the Air Registration Board or any public Authority or Authorities in the United Kingdom to whose jurisdiction control or regulations Air Cushion Vehicles may from time to time be or become subject and in addition such of the details as are manufactured by B.H.C. shall be inspected and released by B.H.C. under its own system of inspection as approved by the said Air Registration Board or any public Authority or Authorities in the United Kingdom to whose jurisdiction control or regulations Air Cushion Vehicles may from time to time be or become subject and such inspection and release shall constitute acceptance of all the goods.

9. WARRANTY

(i) If in any Air Cushion Vehicle, Air Cushion Vehicle components or spares before the completion of 200 hours of use or six calendar months from the date of delivery (whichever period shall first expire) any defect shall appear which arises solely from faulty materials or workmanship, B.H.C. hereby warrants on the return of the part or parts alleged to be defective carriage paid to such of its works as it may direct to make good such defect either by repair or at B.H.C. option by replacement provided that B.H.C. shall be under no liability under this sub-clause if the Air Cushion Vehicle or component part alleged to be defective has been subject to any abnormal conditions or to misuse or neglect or has been involved in any accident or has not been maintained in accordance with proper standards.

(ii) In the case of defects in engines instruments accessories or parts not manufactured by B.H.C. in place of the Purchaser's right set out in sub-clause (i) of this clause the Purchaser will be entitled only to receive the benefit from B.H.C. of all benefits received by B.H.C. under any guarantee or warranty by the supplier to B.H.C.

(iii) The warranty set out in sub-clauses (i) and (ii) of this clause is expressly limited to the despatch to the Purchaser without charge except for carriage and customs or other duties of a new or repaired part and does not include the cost of inspection and any dismantling or re-erection.

(iv) The express warranty contained in this clause is accepted by the Purchaser in place of any warranty condition or liability express or implied by law or otherwise either in contract or in tort or otherwise in respect of any defect in or failure of any Air Cushion Vehicle or component part of any Air Cushion Vehicle or of any spare or replacement parts or ancillary equipment or for any injury loss or damage directly or indirectly attributable to such defect or failure.

(v) Except as expressly provided in this clause B.H.C. will not be liable in contract or in tort or otherwise for any loss or damage sustained by reason of anything done or omitted whether by reason of the negligence of any person or otherwise, whether in advising in regard to or inspecting or supplying any Air Cushion Vehicle or spares or components for Air Cushion Vehicles or their selection fitting supply use repair or modification or in training commanders or engineers or the course of services rendered by B.H.C. engineers. All spare parts or components supplied or advice given or services rendered or training carried out are deemed to be supplied given rendered or carried out on the terms of this clause unless otherwise agreed in writing and signed by B.H.C. The Purchaser agrees to indemnify B.H.C. against all claims against B.H.C. made by persons in the employment of the Purchaser liability for which would have been excluded by this clause if such claims had been made by the Purchaser.

(vi) In the event of a claim being made by the Purchaser or any person in the employment of the Purchaser against any servant of B.H.C. liability for which would have been excluded by this clause if such claim had been made by the Purchaser against B.H.C., B.H.C. shall be entitled to indemnify such servant in respect of such claim and the Purchaser will indemnify B.H.C. in respect of such indemnity.

10. FRUSTRATION

If this contract or any part of it shall become impossible of performance or otherwise frustrated B.H.C. shall be entitled to a fair and reasonable proportion

of the price in respect of the work done up to the date thereof and for this purpose any moneys previously paid by the Purchaser shall be retained by B.H.C. as against the sum due to B.H.C. under this provision, any balance to be repaid to the Purchaser or as the case may be any deficiency to be paid to B.H.C. by the Purchaser. B.H.C. may dispose of the goods as they may think fit, due allowance being made to the Purchaser for the net proceeds thereof.

11. PATENTS

If any goods to be supplied by B.H.C. are to be in accordance with the Purchaser's specification or instructions the Purchaser shall indemnify B.H.C. against all damages, penalties, costs and expenses to which B.H.C. may become liable or which it may incur through complying with any such specifications or instructions, involving an infringement of Patent, Registered Design or Trade Mark.

12. LEGAL INTERPRETATION

The contract will be deemed to be made in England and shall be governed and construed for all purposes and in all respects in accordance with English Law.

CONDITION PARAMOUNT

Condition 9 above is deemed to be incorporated in all contracts made between B.H.C. and the Purchaser, and all other conditions or clauses which may be inconsistent therewith shall be treated as void to the extent of such inconsistency.

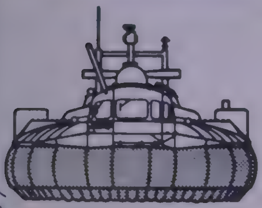
THE BOREAL INSTITUTE
LIBRARY

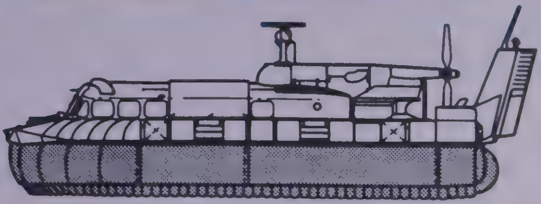
DEC 13 1967

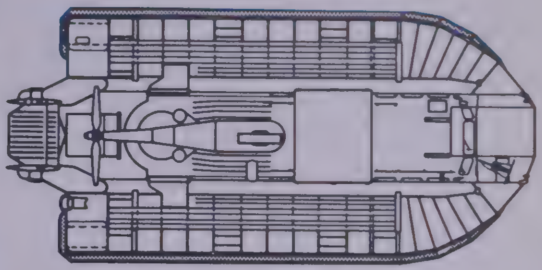
Pam 629.1.039

SR.N6

utility







The SR.N6 (Utility) is a high-performance amphibious hovercraft employing a single engine and an integrated lift and propulsion system. It is in current production. Being truly amphibious, it can operate from relatively unsophisticated bases situated above the high water mark, irrespective of the state of the tide and the depth of the water. It can operate in shallow waters, over marshes and sand-bars, along rivers and through rapids, and over ice and snow.

Incorporating the fully developed systems and components of the SR.N6 already in passenger-ferry service, the design of the SR.N6 (Utility) differs mainly in having a large top-hatch and a wider bow door. Thus, equipment and stores can be loaded and unloaded either by overhead crane or through the bow. As a further facility, palletised loads can be 'floated' in and out on hover-pallets supplied with air from the main engine compressor. Loads of up to ½ ton which are too long for the cabin may be secured on the strengthened decking each side.

A small auxiliary electrical generator unit is fitted for use when electrical power is required for prolonged periods while the main engine is stopped. Communication equipment is grouped together behind the rear bulkhead, with doors for easy access.

Directional control is achieved by two rudders and all-moving tailplanes plus an auxiliary air-porting system. Manœuvrability is further improved by a 'lifting' system fitted to the flexible skirt.

The large top hatch and bow door and the strengthened side decking all combine to make the SR.N6 (Utility) particularly well suited for simple and speedy handling of freight loads, but conversion to other roles can be effected easily. Tie-down points are provided on the cabin floor and rear bulkhead.

Typical uses

Freight carrier   Passenger/freight carrier   Ambulance
Airfield fire suppression and rescue
Amphibious search and rescue   Weed and pest control

LEADING PARTICULARS

	DIMENSIONS—overall
Length	48′ 5″ (14,76 m.)
Beam	23′ 0″ (7,01 m.)
Height on landing pads	14′ 11″ (4,55 m.)
Skirt length	4′ 0″ (1,22 m.)
	DIMENSIONS—internal
Cabin length	19′ 0″ (5,78 m.)
Cabin width	7′ 6″ (2,29 m.)
Headroom—centre line	6′ 0″ (1,83 m.)
Door height	5′ 0″ (1,52 m.)
Door width	4′ 3″ (1,29 m.)
Roof hatch length	7′ 0″ (2,13 m.)
Roof hatch width	7′ 6″ (2,29 m.)
	WEIGHTS
Basic	6 tons (6,1 tonnes)
Normal gross	10 tons (10,2 tonnes)
Maximum (overload)	11 tons (11,2 tonnes)
	POWER PLANT AND SYSTEMS
Main engine	Bristol Siddeley Marine 'Gnome' 1051 at 900 s.h.p. maximum continuous power
Auxiliary power plant	Petter DA.1 diesel engine, 6½ h.p.
Fan	BHC 12-bladed, centrifugal, 7′ 0″ (2,13 m.) dia.
Propeller	Dowty Rotol 4-bladed, variable pitch, 9′ 0″ (2,74 m.) dia.
Fuel capacity (normal)	265 Imp. gall. (1.205 litres)
	PERFORMANCE (at 7·7 tons operating weight, I.S.A. conditions)
Maximum speed, calm water (maximum power)	60 knots (111 km./hr.)
Maximum speed, calm water (maximum continuous power)	56 knots (104 km./hr.)
Speed in 4–5 ft. waves (1,2–1,5 m.) (airspeed into wind)	45–55 knots (83–102 km./hr.)
Endurance (normal fuel)	3½ hours

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited.

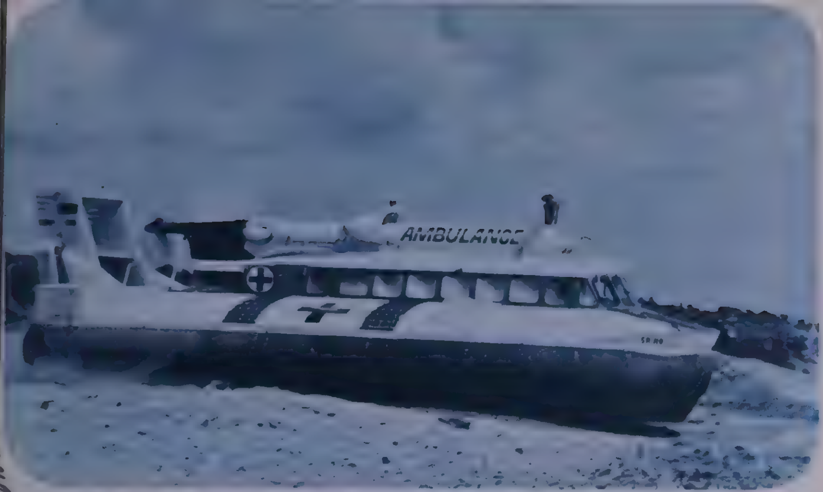
British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

Publication No. SP 1443 Issue 1 May 1967 Printed in England

BHC
british hovercraft corporation limited
YEOVIL, ENGLAND

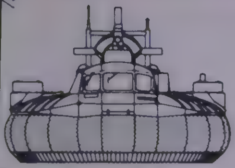
THE BOREAL INSTITUTE
LIBRARY

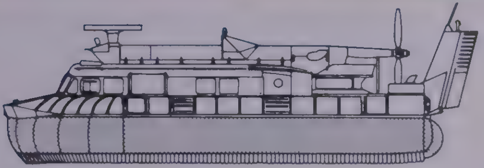
DEC 13 1967

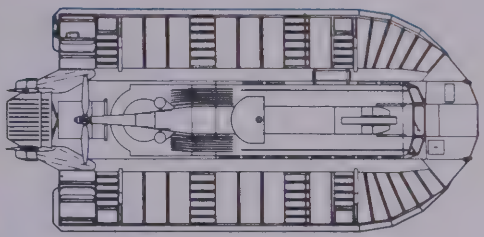


SR.N6

mobile dispensary/ medical centre







The SR.N6 Mobile Dispensary Medical Centre is a high-performance amphibious hovercraft employing a single engine and an integrated lift and propulsion system. Being truly amphibious, it needs relatively unsophisticated bases ashore and can operate irrespective of the state of tide and the depth of water. The SR.N6 can operate in shallow waters, over marshes and sand-bars, along rivers and through rapids, and over ice and snow. Navigational aids, including radar, enable the craft to operate at night and in other conditions of low visibility.

Incorporating the fully developed systems and components of the SR.N6 already in passenger ferry service, the design of the SR.N6 mobile dispensary medical centre differs mainly in having the passenger cabin converted to provide a comprehensively equipped medical centre. A waiting room tent is stowed in the starboard pannier to provide additional covered accommodation for patients when the craft is stationary operating as a clinic. Within the fully air-conditioned cabin are an examination room and an operating theatre. The examination room is also fully equipped as a dispensary with storage space and stretcher stowage. Through this room there is easy access for stretchers to the operating theatre. The theatre has an operating table and a dental treatment chair, each with separate equipment stores but sharing refrigeration and sterilisation facilities. Oxygen and gases required for surgery are stored in bottles adjacent to the operating table.

A tank for fresh water is externally mounted to serve the dispensary. Additional power for lighting and surgery equipment is provided by a small auxiliary electrical generator unit while the main engine is stopped.

This versatile craft is able to take medical teams into areas hitherto requiring prolonged journeys in conventional vehicles or numerous helicopter sorties. Recent trials have shown that river journeys which previously took ten days can be reduced to as little as eight hours. In the medical role the SR.N6 carries a team of four but, with the heavy equipment removed, the craft could be used in the evacuation role and carry up to fifty people.

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

Publication No. SP 1559 Issue 1 May 1967 Printed in England

LEADING PARTICULARS

	DIMENSIONS
Overall length	48′ 5″ (14,76 m.)
Overall beam	23′ (7,01 m.)
Overall height on landing pads	15′ (4,57 m.)
Cabin size (length × beam)	21′ 9″ × 7′ 8″ (6,62 m. × 2,34 m.)
Cabin floor area	166 sq. ft. (15,42 sq. m.)
Door aperture size (height × width)	5′ 9″ × 3′ 3″ (1,75 m. × 0,99 m.)
Skirt length	4′ (1,22 m.)
	POWER PLANT AND SYSTEMS
Engine	Bristol Siddeley Marine 'Gnome' 1051
Max. continuous rating at 15° c	900 s.h.p.
Propeller	Dowty Rotol, 4-blade, variable pitch, 9 ft. dia. (2,74 m.)
Lift fan	BHC centrifugal, 7 ft. dia. (2,13 m.)
Fuel capacity	265 Imp. gall. (1.205 litres)
	WEIGHTS
Normal gross weight	8·9 tons (9,1 tonnes)
Max. gross weight	10·3 tons (10,5 tonnes)
	PERFORMANCE (at 17,300 lb. operating weight (7.847 kg) at 15 c
Maximum speed over calm water (max. power)	60 knots (111 km/hr)
Maximum speed over calm water (max. cont. power)	56 knots (105 km/hr)
Speed in 4–5 ft. waves	45–55 knots (83–102 km/hr)
Still air range	200 n. miles (370 km)

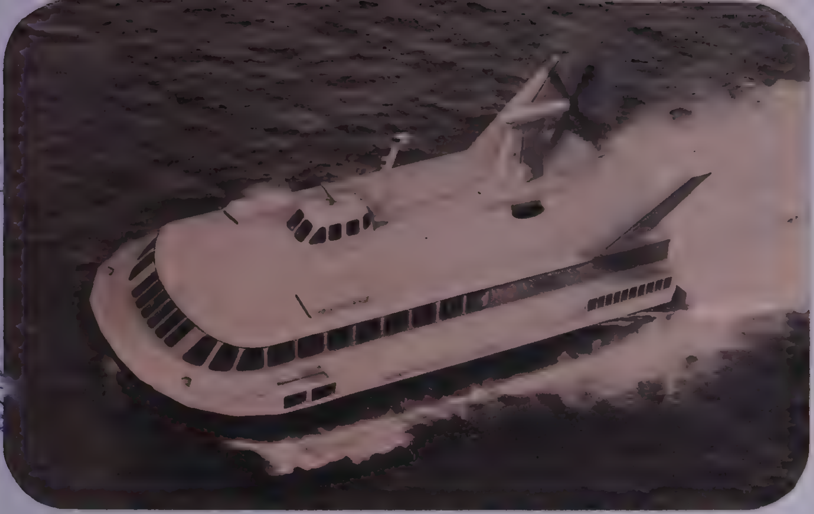
POLAR
PAM
4646

POLARPAM

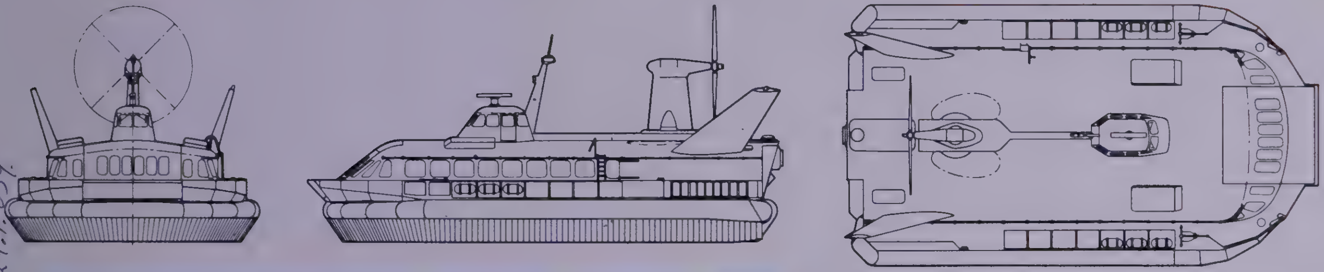
BHC
british hovercraft corporation limited
YEOVIL, ENGLAND

THE BOREAL INSTITUTE
LIBRARY
DEC 13 1967

B.H.C L.19
PAM. 629.1.039



BH.7



The latest addition to the B.H.C. range of commercial craft is the 40-ton BH.7, a fast economic ferry designed for short haul operations across either sheltered or open water routes. Being fully amphibious, this craft possesses the operational flexibility inherent in all B.H.C. craft, and it brings, for the first time, to small/medium capacity hovercraft, extremely competitive operating economics comparable to those of the much larger SR.N4.

Its spacious cabin area can be fitted out in a variety of layouts, each designed to meet the particular demands of traffic on different types of routes. The standard craft can carry 138 passengers, but high-density seating arrangements can accommodate up to 180 passengers for service on commuter routes.

As a mixed traffic craft, 72 passengers and six to eight cars can be carried, the latter being housed in the main central cabin. On all variants, a large bow door is used for loading the main cabin and smaller side entrances are used for the port and starboard passenger cabins.

Although new in design, the BH.7 makes extensive use of components and constructional techniques employed on the SR.N4 and the engine, transmission gearboxes and propeller are identical to those on the larger craft. Directional control is achieved by the swivelling propeller pylon, the two fins and an air-porting system similar to that used on the SR.N6.

LEADING PARTICULARS

	DIMENSIONS
Overall length	76′ 7″ (23,3 m.)
Overall beam	41′ 3″ (12,6 m.)
Overall height on landing pads	33′ 0″ (10,1 m.)
Bow door	13′ 9″ × 7′ 9″ (4,2 m. × 2,4 m.)
Headroom, car deck	7′ 9″ (2,4 m.)
Skirt length	5′ 6″ (1,7 m.)
	POWER PLANT AND SYSTEMS
Engine	Bristol Siddeley 'Marine Proteus'
Max. continuous rating	3,400 s.h.p.
Auxiliary power unit	One Rover 2S/150 gas turbine driving a 55 KVA alternator
Propeller	Hawker Siddeley Dynamics, 4-blade, variable pitch, 19 ft. (5,8 m.) dia.
Lift fan	BHC, centrifugal, 11 ft. 6 in. (3,5 m.) dia.
Fuel capacity	3 tons (3,1 tonnes)
	WEIGHTS
Empty	32.4 tons (33 tonnes)
Normal gross	40 tons (40,6 tonnes)
Maximum (overload)	50 tons (50,8 tonnes)
	PERFORMANCE (at 40 tons operating weight, I.S.A. conditions, maximum continuous rating)
Maximum speed in calm conditions	64 knots (119 km/hr)
Water speed into 15 knot (28 km/hr) wind and 4 ft. (1,2 m.) seas	50 knots (93 km/hr)
Endurance	3 hours

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited.

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

SP. 1622 Issue 1 July 1967 Printed in England

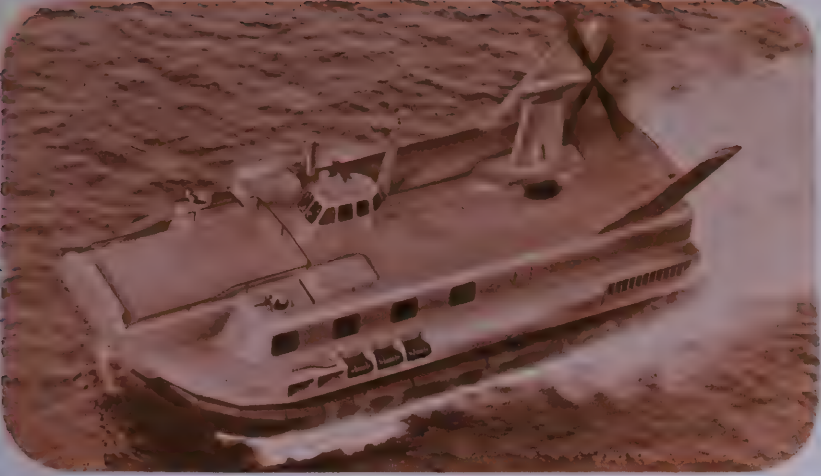
WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

YEOVIL ENGLAND british hovercraft corporation limited

Pam: 629.1.03

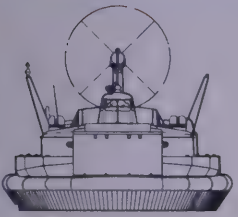
THE BOREAL INSTITUTE
LIBRARY

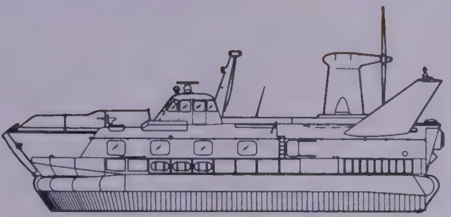
DEC 13 1967

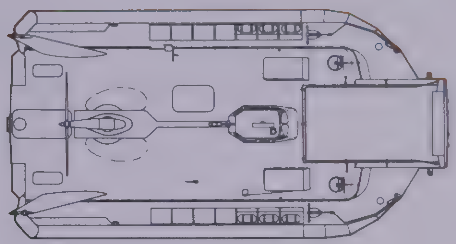


BH.7

logistic amphibious craft







The BH.7 is a medium-sized, single-engined hovercraft designed to fill the gap between the 9-ton SR.N6 and the 165-ton SR.N4. It has a nominal gross weight of 40 tons and is capable of overloading to 50 tons.

The form of construction of the buoyancy tank and components, such as the fan, are similar to those used in the SR.N4. The engine, transmission gearboxes, pylon and propeller are identical to those used in the larger craft.

The main cabin provides an unobstructed area suitable for carrying wheeled vehicles and weapons, while the two side cabins will accommodate smaller equipment and troops. The main access is over the bow ramp or through the top hatch, both 14 feet wide. The top hatch cover slides back under the fixed part of the roof and may be left open when carrying a vehicle with a high cab such as a 4½-ton truck.

Some typical loads are:

170 equipped troops, or

3 field cars and trailers plus 60 troops, or

One 4½-ton truck, 2 jeeps and 60 troops or

2 armoured scout cars, or

Up to 20 NATO pallets

Endurance on normal fuel is 3 hours, but fuel tanks allow for a maximum of 10 hours.

Directional control is achieved by the swivelling pylon, the two fins and an auxiliary air-porting system similar to that incorporated in the successful SR.N6.

The British Government is ordering BH.7s for logistic support and for naval use.

LEADING PARTICULARS

	DIMENSIONS – overall
Length	80′ 0″ (24,5m.)
Beam	41′ 3″ (12,6m.)
Height on landing pads	33′ 0″ (10,1m.)
Skirt length	5′ 6″ (1,7m.)
	DIMENSIONS – internal **Main Cabin**
Length of deck	49′ 0″ (14,9m.)
Width	13′ 9″ (4,2m.)
Height (minimum)	6′ 11″ (2,1m.)
Height (on centre line)	7′ 6″ (2,3m.)
	DIMENSIONS **Side cabins – each of two**
Length	35′ 0″ (10,7m.)
Width	6′ 0″ (1,8m.)
Height (minimum)	6′ 7″ (2,0m.)
	POWER PLANT AND SYSTEMS
Main engine	Bristol Siddeley Marine 'Proteus' at 3,400 s.h.p. maximum continuous power.
Auxiliary power plant	Two Rover 2S/150 gas turbines
Fan	BHC 12-bladed, centrifugal, 11′ 6″ (3,5m.) dia.
Propeller	Hawker Siddeley Dynamics (HSD) 4-bladed, controllable pitch, 19′ 0″ (5,8m.) dia.
Fuel capacity (normal)	3 tons (3 tonnes) 840 Imp. gall. (3.800 litres)
	WEIGHTS
Empty	30.4 tons (30,5 tonnes)
Normal gross	40 tons (40,6 tonnes)
Maximum (overload)	50 tons (50,8 tonnes)
	PERFORMANCE (at 40 tons operating weight, I.S.A. conditions, maximum continuous rating).
Maximum speed in calm conditions	64 knots (119 km/hr.)
Water speed into 15 knot (28 km/hr.) wind and 4 ft (1,2m.) seas	50 knots (93 km
Endurance (normal fuel)	3 hours

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited.

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

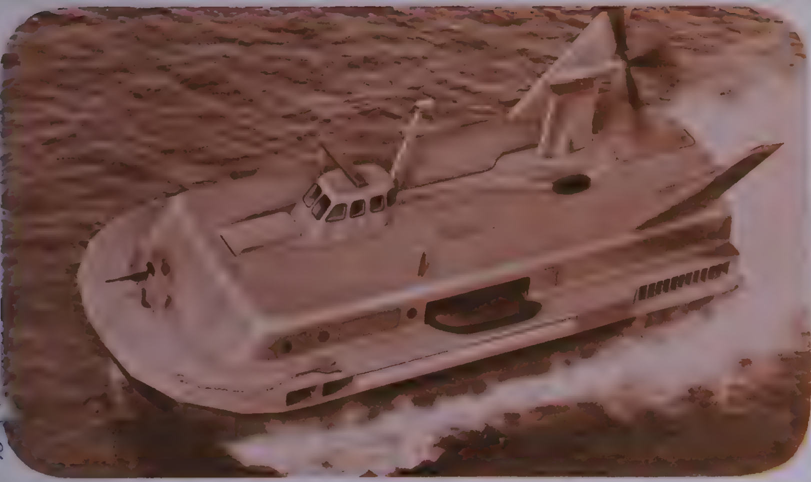
WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

Publication No. SP 1445 Issue 2 May 1967 Printed in England

BHC
british hovercraft corporation limited
YEOVIL, ENGLAND

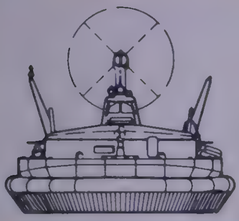
THE BOREAL INSTITUTE
LIBRARY
DEC 13 1967

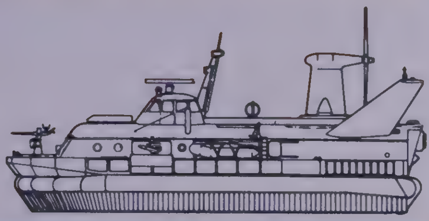
B.H.C. L.17
Pam. 629.1.039

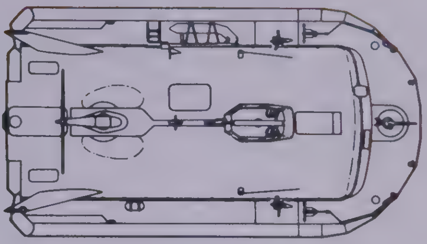


BH.7

fast attack craft







The BH.7 is a medium-sized, single-engined hovercraft designed to fill the gap between the 9-ton SR.N6 and the 165-ton SR.N4. It has a nominal gross weight of 40 tons and is capable of overloading to 50 tons.

The form of construction of the buoyancy tank and components such as the fan, are similar to those used in the SR.N4. The engine, transmission gearboxes and propeller are identical to those used in the larger craft.

Because of the large cabin floor area of over 1,000 square feet (approximately 100 square metres) generally unobstructed except by the two main longitudinal walls, operational layouts can be arranged to meet particular requirements. In a typical layout, the operations room is placed directly beneath the control cabin and contains communication, navigation, search and strike electronic equipment and associated displays. Armament could include a rapid-fire medium calibre gun with full fire control and/or surface to surface or surface to air missile installations.

The craft has an endurance of 10 hours under cruise conditions but this can be considerably extended on operations as it can remain 'on watch' without using the main engine. There is also accommodation for the crew to live on board for several days.

Directional control is achieved by the swivelling propeller pylon, the two fins and an air-porting system similar to that used on the SR.N6.

The British Government is ordering BH.7s for logistic support and for naval use.

LEADING PARTICULARS

	DIMENSIONS – Overall
Length	76′ 6″ (23,3 m.)
Beam	41′ 3″ (12,6 m.)
Height on landing pads	33′ 0″ (10,1 m.)
Skirt length	5′ 6″ (1,7 m.)
	POWER PLANT AND SYSTEMS
Main engine	Bristol Siddeley Marine 'Proteus' at 3,400 s.h.p. maximum continuous power.
Auxiliary power plant	Two, Rover 2S/150 gas turbines
Fan	BHC 12-bladed, centrifugal, 11′ 6″ (3,5 m.) dia.
Propeller	Hawker Siddeley Dynamics (HSD) 4-bladed, controllable pitch, 19′ 0″ (5,8 m.) dia.
Fuel capacity	10 tons (10,2 tonnes)
	WEIGHTS
Empty	32.4 tons (33 tonnes)
Normal gross	40 tons (40,6 tonnes)
Maximum (overload)	50 tons (50,8 tonnes)
	PERFORMANCE (at 40 tons operating weight, I.S.A. conditions, maximum continuous rating).
Maximum speed in calm conditions	64 knots (119 km/hr)
Water speed into 15 knot (28 km/hr) wind and 4 ft. (1,2 m) seas	50 knots (93 km/hr)
Endurance	10 hours

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with The British Hovercraft Corporation Limited

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

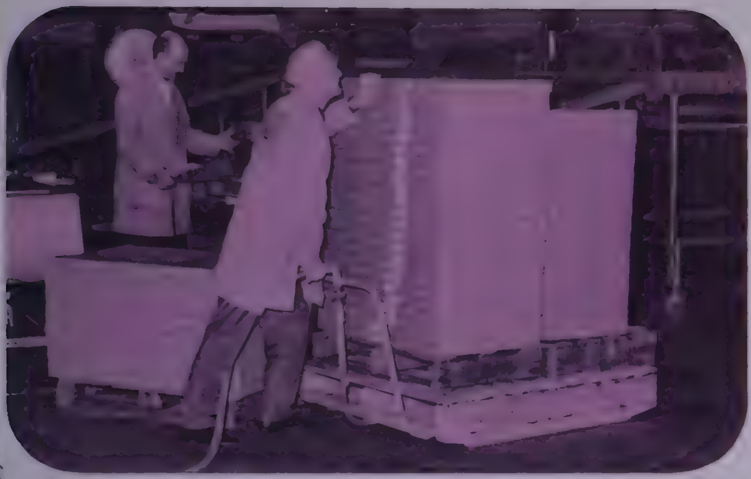
WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

Publication No. SP 1628 Issue 1 May 1967 Printed in England

british hovercraft corporation limited
YEOVIL, ENGLAND

THE BOREAL INSTITUTE
LIBRARY

DEC 13 1967



1 ton flotaload hoverpallet

FLOTALOAD
BHC

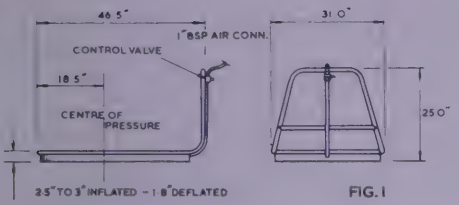
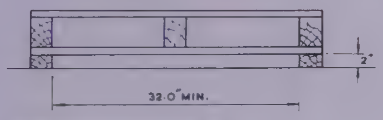
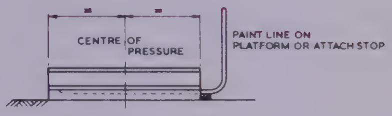


FIG. 1



MODIFICATION TO STANDARD FORK LIFT PALLET FOR USE WITH FLOTALOAD HOVERPALLET

FIG. 2



LOADING DIAGRAM

FIG. 3

The 1 ton FLOTALOAD hoverpallet consists of a tubular handle fitted to a load carrying platform with four easily removable diaphragm assemblies underneath and a peripheral skirt. Air is supplied through a 1 in. BSP connector and a control valve.

This FLOTALOAD model is designed to suit a variety of requirements for moving loads of up to 1 ton on smooth floors. Operators already in possession of standard fork lift pallets can easily modify them for use with the hoverpallet thus integrating the advantages of both fork lift trucks and FLOTALOAD hoverpallets.

Loads may be placed directly onto the platform of the FLOTALOAD hoverpallet, but it is suggested that a simple bridge system may prove more economical as this allows the FLOTALOAD to be slid under the load. Figure 2 shows how a standard fork lift pallet may be modified.

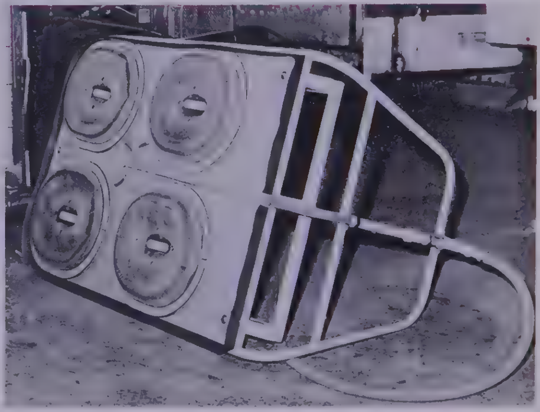
When inserting the FLOTALOAD under the 'bridge' the centre of pressure should be approximately under the centre of the load as fig. 3. A line can be painted on the platform to show how far it should be slid under for a particular load.

To operate FLOTALOAD the control valve is opened until the load is airborne. The load can then be pushed, pulled or spun with the minimum of effort, and when the desired position is reached the control valve is simply closed and the FLOTALOAD withdrawn.

FLOTALOAD will operate satisfactorily over any smooth non-porous surface. Sheet metal, linoleum, vinyl, sealed concrete, plywood, smooth asphalt, and similar materials are all suitable.

On smooth surfaces the pressure required at the air inlet connection is 8 lbf/in^2 minimum and the airflow approximately 20 scfm. Under these conditions a load of 1 ton requires approximately 6 lbf. effort to initiate movement.

The size of airline required will depend on the pressure of air available and length of hose. Thus a 15 lbf/in^2 compressor will require a 1 in. bore hose whereas a 100 lbf/in^2 compressor needs only a $\frac{1}{2}$ in. bore hose.



The only accessory equipment needed is a 1 in airline and an air supply from a factory or workshop system, or from a separate compressor. Advice can be given on suitable types of air lines and compressors.

If you are in any doubt about the suitability of FLOTALOAD in your operations a representative trial can be arranged.

New FLOTALOAD hoverpallets are being added to our range. We can also advise on special applications.

FLOTALOAD is designed and manufactured under British Patent No. 985235 and corresponding foreign patents Other patents applied for.

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited.

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

SP. 1576 Issue 2 July 1967 Printed in England

WESTLAND AIRCRAFT LTD SAUNDERS ROE DIVISION

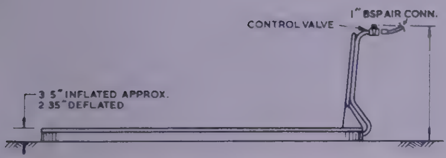
BHC
YEOVIL ENGLAND
british hovercraft corporation limited

THE BOREAL INSTITUTE
LIBRARY

DEC 13 1967

5 ton flotaload hoverpallet

FLOTALOAD BHC



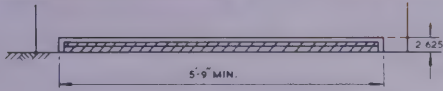


FIG. 2

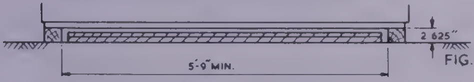


FIG. 3

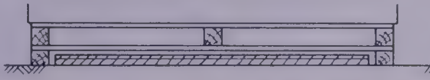
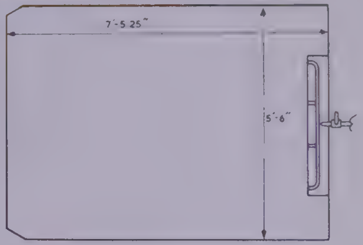


FIG. 4



The 5 ton FLOTALOAD hoverpallet consists of aluminium alloy corrugated web with 12 swg aluminium skins bonded top and bottom to form a strong sandwich contruction. On the underside are mounted 6 easily removable flexible diaphragms. A peripheral skirt surrounds the platform, and a robust handle at one end contains the control valve. Spherical castors on the underside of the platform allow the FLOTALOAD to be easily slid under a container, (See figs. 1 and 2).

This FLOTALOAD hoverpallet is designed to move loads and containers up to 5 tons gross weight on smooth floors. Operators possessing flat bottomed containers or fork lift pallets can easily modify them for use with the hoverpallet as shown in figs. 3 and 4 thus integrating the use of containers, fork lift trucks and FLOTALOAD.

To operate FLOTALOAD the control valve is opened until the load is airborne, the load is then pushed to its new position, and the control valve closed to ground the load.

FLOTALOAD will operate satisfactorily over any smooth non-porous surface. Sheet metal, linoleum, vinyl, sealed concrete, plywood, smooth asphalt, and similar materials are all suitable. On smooth surfaces the pressure required at the air inlet connection is 15 lb f/in^2 minimum and the airflow approximately 110 scfm. Under these conditions a load of 5 tons requires approximately 18 lbf. effort to initiate movement.

The only accessory equipment needed is either an industrial airline or a mobile compressor. Maintenance is greatly simplified by the absence of mechanical parts.

The size of airline required will depend on the pressure of air available and the length of hose required. For most applications a 1 in. bore hose will be sufficient.

If you are in any doubt about the suitability of FLOTALOAD in your operations a representative trial can be arranged.

New FLOTALOAD hoverpallets are being added to our range. We can also advise on special applications.

FLOTALOAD is designed and manufactured under British Patent No. 985235 and corresponding foreign patents Other patents applied for.

POLAR
PAM
4646

POLARPAM

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited.

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

SP. 1585 Issue 2 July 1967 Printed in England

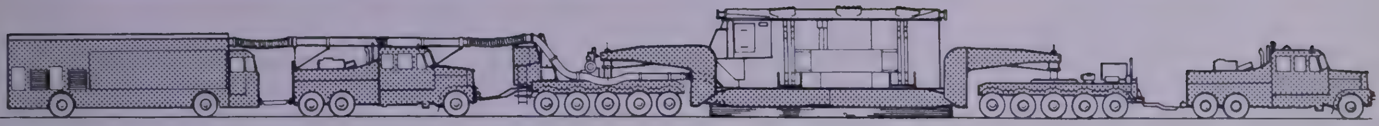
BHC
YEOVIL ENGLAND british hovercraft corporation limited

THE BOREAL INSTITUTE
LIBRARY

DEC 13 1967

Pam 629.1.035 BHC

air cushion heavy load transporter



This vehicle has been developed to facilitate the movement by road, of heavy industrial equipment such as electricity transformers, by distributing more evenly the load imposed on bridges.

This is achieved by using air-cushion equipment located under the central load-carrying platform of the transporter.

The development of this equipment was prompted initially by the Central Electricity Generating Board, which is constantly faced with route-planning problems caused by the high weights of laden transporters.

Transformer units now going into service weigh between 195 and 250 tons and on occasion the C.E.G.B. has been involved in the heavy expense of strengthening and even rebuilding bridges to accept these loads when no alternative route has been available.

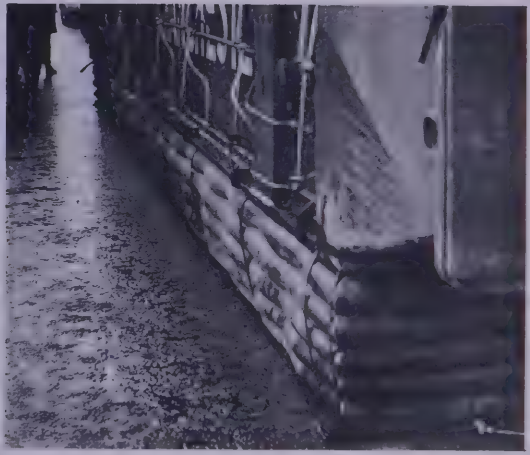
The use of air-cushion equipment, however, provides a practical and economic alternative.

On its first commercial trip in February, 1967, the converted transporter had to cross the Felin Puleston Bridge near Wrexham in North Wales, carrying a 155-ton transformer. Using the air-cushion equipment, it was possible to reduce stress on the bridge by 70 tons, bringing it well within the load limitations imposed by the Ministry of Transport.

Without the air-cushion equipment, it would have been necessary in this instance to rebuild the bridge at a cost of £30,000. This saving represents half of the total development cost of the transporter.

The cushion of air itself is contained in a curtain of nylon/neoprene, stretched as a seal beneath the load platform and formed into convolutions about its periphery. It is protected from wear through contact with road surfaces, by steel plates. Any uneveness of road surfaces causes the convolutions to flex but allows the plates to remain in contact with the road, thus maintaining the air seal.

The cushion is capable of lifting 155 tons, at which point the pressure reaches 5.4 p.s.i.g. The power to generate and maintain this pressure is provided by four Rolls Royce B.81 petrol engines, delivering 235 h.p. at 4,000 r.p.m., which are housed in a sound-proofed vehicle at the rear of the transporter. Air is fed to the cushion by ducting.



To avoid possible damage to bridges due to sudden fluctuations in cushion pressure, this is controlled automatically to very close tolerances. Should one power source fail, it is automatically sealed off. In normal operation, 25% of the air supply is blown to waste but in the event of a power unit failure, this is automatically diverted into the cushion, thus maintaining a constant cushion pressure. The whole system is sound-proofed to satisfy stringent limitations on noise level laid down by the Ministry of Transport, and the air cushion does not affect other road users.

When the cushion is not needed, the curtain can be quickly detached and folded for stowage.

'Whilst it is believed that the contents of this document are correct at the time of going to press it must be appreciated that this brochure is for information purposes only and that it does not form the basis of any Contract with British Hovercraft Corporation Limited

British Hovercraft Corporation is a subsidiary of Westland Aircraft Limited.

WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION

Publication No. SP 1617 Issue 1 May 1967 Printed in England

BHC
YEOVIL ENGLAND british hovercraft corporation limited

HOVERCRAFT FOR MILITARY USE

By A.J.I. Poynder

British Hovercraft Corporation Limited,
Yeovil,
Somerset.

Reprinted from New Scientist, March 30, 1967. Pages 674 to 676

POLAR
PAM
4646

POLARPAM

THE BOREAL INSTITUTE
LIBRARY
DEC 13 1967

HOVERCRAFT FOR MILITARY USE

by A. J. I. Poynder

British Hovercraft Corporation, Isle of Wight

They come into service with the Army this year. Also two experimental hovercraft designed specifically for military purposes—fast patrol work and logistics support—are to be ordered for the British forces, according to the recent White Paper on defence

Evaluation trials of hovercraft have now been carried out over water, and over most forms of terrain with the obvious exceptions of jungle, hills and built-up areas. Hovercraft have been used at sea and in surf, in river environments and over rapids, across beaches, marsh and desert, and over ice and snow, in temperatures ranging from −30°C to 40°C.

The initial testing phases having proved what they can (and cannot) do, it is now a question of what use they can be put to in military operations.

With such a completely novel form of mobility, however, there is no operational pattern to work from, and there is a lack of previous operational experience on which to base our judgment. This means that if Britain is to exploit what she has so far achieved and not lose her lead by lethargy, some imagination and new thought has to be exercised in applying these new craft to actual military situations.

In order to avoid too many unknowns and to obviate the need for crystal balls, I intend to confine this consideration of military hovercraft to what is available now or will become available within the next three years. Opportunities can so easily be lost by those who advocate waiting for something that might be better in the future. This has been particularly so in the field of military equipment, and we must not fall into the trap this time.

The timescale we are considering, therefore, is 1966–70, and the types of hovercraft and associated weapons and equipment are those in production or being developed now, the capabilities of which are already known. Table 1 shows relevant types and their characteristics.

But first, in order to see how present-day hovercraft can be fitted into the pattern of military equipment, we must be clear about the sort of advantages they give, and their limitations. Their greatest value is of course their amphibious capability and their ability to cross terrain impassable to other forms of vehicles. On the water they are comparable with the fastest patrol boats in rough weather, and considerably faster than any type of conventional craft in good weather.

Hovercraft are built with light, strong structures which are not particularly vulnerable, and they will continue to operate effectively even after considerable damage to structure and skirts. They cannot be torpedoed. They can be armoured, but being "weight conscious" any indiscriminate armouring will detract from their performance.

Because of the high standard of technology used in their design, they are at present more expensive, and in some instances need more maintenance than conventional land or sea vehicles; but, because of the different safety problem, are cheaper and easier to maintain than a helicopter. They are basically simple to operate and require no elaborate bases or support installations.

This present generation of craft is relatively noisy it is true but, in spite of the rather large form, the craft are easy to camouflage and do not make particularly good radar targets. On dry and sandy soil they make a dust cloud (which can be controlled by operating techniques); but particularly on wet ground they do not leave much "signature". At sea they make little or no wash, and are difficult for submarines to detect as they have no hull or propeller in the water.

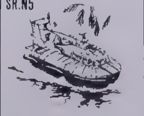
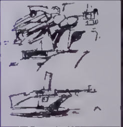
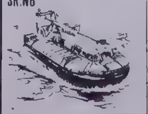
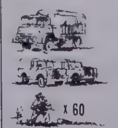
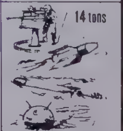
They can operate in mist or fog, by day or night, using radar. They can carry guns, guided weapons, torpedoes or mines and, although they have relatively short endurance, particularly compared to ships, they have high speed and rapid interception capabilities and can operate under overload conditions with a high degree of flexibility.

Finally, there is the problem of deployment. Only the small ones (SR.N5/6) can be deployed by air. The medium ones (BH.7) can be shipped on heavy lift ships, in landing ships (deck) or in assault ships; while the large SR.N4 would have to be ferried by stages using its own power (with some weather limitations).

To sum up, then, hovercraft are not yet ocean-going craft and militarily they are best employed in coastal waters, inshore or ashore. It is their amphibious capability, coupled with their speed, that gives them their greatest potential for military use. Add to these two attributes some of their other advantages—such as the ability to operate in bad visibility and their poor radar signature—and we can see how they might be fitted into military roles.

Ground operations—As far as ground operations are concerned, hovercraft are basically a means of mobility for men and weapons, stores and equipment, from ship to shore and along coasts, up rivers and over terrain where movement of

Table 1 Types of hovercraft and some military characteristics

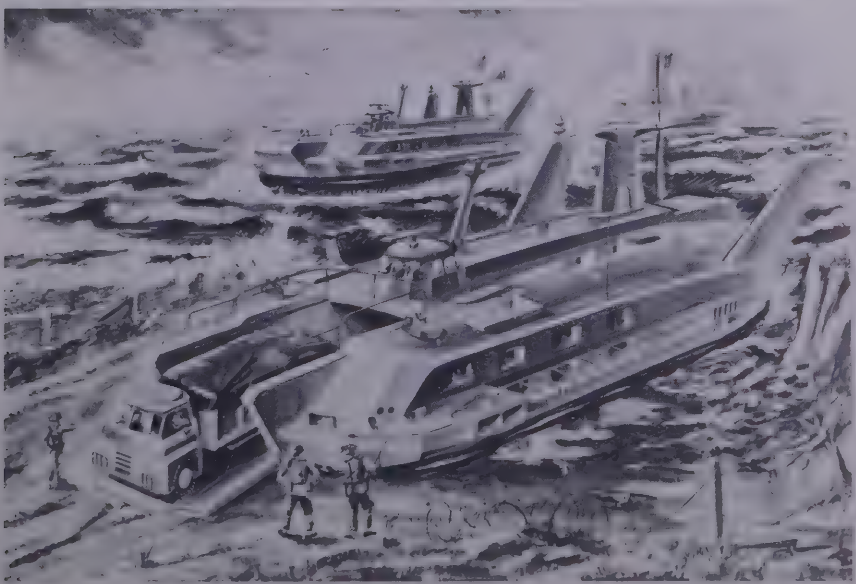
CRAFT	SPEED calm water	MAXIMUM A.U.W. tons	MAXIMUM DISPOSABLE LOAD tons	TROOP CARRYING CAPACITY	TYPICAL MILITARY LOADS	WEAPONS IN ATTACK OR SUPPORT ROLE
SR.N5 	62kt.	9	4	15		
SR.N6 	56kt.	12	6	30		
BH.7	64kt.	50	24	170		
SR.N4	70 kt.	180	80	500		

Deployment by air of a small hovercraft

ordinary vehicles is too slow, too difficult or even impossible. Each size of hovercraft can be used for these sorts of tasks. They can be armed with automatic weapons such as 7.6-mm or 0.5-in machine guns, rockets, the Vigilant missile or the SS11 type of guided weapon, to give support to the infantry they are carrying; although of course at the expense of some of the disposable load. Applique armour can also be carried to protect crew and troops from enemy small arms fire.

They can operate when weather conditions such as morning mist limit the use of helicopters, and can be used in conjunction with helicopters to clear enemy from scrub and swamp in operations similar to those carried out so successfully by the Americans in the "Plain of Reeds" in Vietnam last December. In these sorts of cases they may make a valuable contribution to the element of surprise.

Large hovercraft in the roles of troop and weapon carrying and logistics support



In the ship-to-shore role, either the journey time is decreased or alternatively ships being unloaded can stand farther off shore. Being unhindered by tide, current and draught, hovercraft can operate over beaches which otherwise would be temporarily or permanently inaccessible, and they can move inland to suitable areas for loading and unloading. So a greater degree of flexibility is possible in the choice of beaches and landing areas. Congestion on beaches will be reduced and double handling eliminated. When not operating, they can be concealed up rivers or on land—away from the beach.

Their speed advantage over conventional amphibians—possibly ten times as fast over water—reduces significantly the time and in some cases the vulnerability when crossing water obstacles. The high speed and consequently high work factor means that fewer hovercraft are required to deliver a given quantity of material in a given time. Thus, fewer logistic support craft have to be deployed, with economy in manpower and probably in shipping space.

In coastal areas, up rivers and over difficult terrain such as marsh, ice and snow, hovercraft used for logistic support are likely to be the fastest and most economic means. This was proved to be the case in Borneo when SR.N5 hovercraft were used up 300 miles of river, cutting boat times from 10 days to eight hours, for tasks normally requiring a combination of fixed-wing aircraft and helicopter lift.

The ability to be able to hide in unlikely places can also be used when hovercraft are used to improve the mobility of a headquarters. For specific assault operations or operations in marsh or delta areas hovercraft could be permanently fitted out as headquarters. On other occasions they can be readily adapted to transport a commander and his staff with the necessary command and communications equipment.

Finally, they can be used for medical evacuation and in the aid to civil power role, particularly in emergencies such as floods.

Para-military operations—Countries that in the past have relied on other nations to patrol their coast lines, or which have long river frontiers to protect, now need their own coastguard and gendarmerie craft. The small hovercraft fits this role perfectly since it can carry weapons and a detachment of troops, it can watch by radar, and can give chase and deal with minor infiltration or smuggling inshore, and ashore if necessary. Also it needs no harbours or bases, so the "overheads" are small; and does not require such detailed knowledge of tides, currents or water depths as is needed for conventional marine craft. Nor does it need the amount of flying training, navigational ability or sophisticated facilities for maintenance of a helicopter.

In short a small hovercraft provides a very cost-effective craft for emergent nations.

Naval operations—For naval use a new, exciting and more sophisticated role for the medium and large hovercraft is their use as "interceptors", to carry out naval coastal patrol duties. Using their ability to operate off beaches, hovercraft employed in this role can wait on shore, rather than remaining at sea in the conventional way. Being amphibious, they can be deployed to any one of a number of beaches in readiness for operations as fast interception and strike craft. Using radar, either shore-based or craft-borne or both, the hovercraft are then directed on to their targets. They would have limited endurance, but could come back to temporary or subsidiary bases to re-arm or re-fuel. Their operation would be very like that envisaged for V/STOL fighter aircraft.

Operating at speed with safety in shallow waters, and over reefs and sandbars, interceptor hovercraft have considerable advantages over conventional craft and, whereas their opponents are likely to be good radar targets, they themselves are not.

Crew and armament can be chosen to suit the particular role, which ranges from fishery protection to intercepting and attacking enemy shipping, amphibious craft, or light naval forces. For limited endurance, sophisticated long-range weapons can be mounted with associated fire control and navigational equipment; and if the threat warrants it a proportion of craft could be equipped with low-level anti-aircraft guided weapons to escort and protect the attacking force.

Other naval uses are in the anti-submarine and minelaying roles. These are both only inshore roles at present, and complementary to, or to replace helicopters rather than as replacement for conventional anti-submarine or minelaying vessels.

Equipped with sonar, radar, communication and homing devices, however, hovercraft can operate as submarine search craft. Using an intermittent dunking technique, and running their engines at low power when sitting on the water, their endurance can be extended by about 50 per cent above normal sortie time. When operating conditions permit, this extended endurance can be increased even further by taking on extra fuel; the degree of overload would reduce the performance only marginally during the first half of the sortie.

Their radar, being low over the water, is particularly effective in picking up submarine periscopes, and their dash capability gives them the ability to carry out a much more rapid search and attack than surface craft. They can carry roll-off torpedoes and provide a very stable platform for tube launching.

Hovercraft can also be used for small-scale minelaying. The main advantage is that a hovercraft can be rapidly loaded ashore, and has a very fast transit speed enabling it to block off channels very rapidly particularly in an archipelago area.

Crash/rescue role—Lastly, there is one very important air force role, and that is for crash/rescue. Hovercraft can be equipped for search, rescue and fire suppression duties and can operate over the shallow waters, marsh, mud and other difficult surfaces which are found so often around airfields.

At some states of the tide, movement by ordinary surface craft is often very slow or impossible; and even the flexibility of helicopters is offset by the number of survivors which they can carry in addition to their role equipment, and the fact that they cannot set down on soft soil to fight a fire. Hovercraft can also operate at night, in fog, and in bad visibility conditions when crashes so often occur.

Hovercraft in this role can search by radar if necessary, move quickly by a direct route, remain on station for long periods and operate with considerable overloads.

Thus for land operations and for amphibious operations while not necessarily replacing any military vehicle or craft as such, hovercraft can be used for many tasks that no other vehicle or craft can do under similar circumstances, and are the most effective method of carrying out a number of roles such as weapon carrying, logistic support and command and control when their amphibious and speed capabilities can be exploited.

For a number of the smaller countries they can provide the ideal coastguard/gendarmerie para-military patrol and intercept craft.

For naval use, as well as adding to the anti-submarine armoury for coastal and inshore work, hovercraft provide a completely new concept of operations when used in the "interceptor" role.

And to complete the inter-service picture, for airfield crash/rescue on many airfields they can replace conventional crash/rescue craft.

Anthony John Irvine Poynder, 47, is chief technical engineer (sales) for the British Hovercraft Corporation, where he deals with such aspects as market research, special applications for the air-cushion principle, hoverpallets and military hovercraft. Previously a regular officer with the Royal Engineers, he holds the Military Cross. Mr Poynder is author of a book for children, *Wahid—the little camel*

Small (SR.N5) hovercraft deployed in the crash/rescue role

The British Hovercraft Industry 1966

POLAR
PAM
4646

Reprint from Interavia / Aviation · Astronautics · Electronics, Issue 9/1966

POLARPAM

THE BOREAL INSTITUTE
LIBRARY
DEC 13 [illegible]67

The British Hovercraft Industry 1966

The modifications to the SBAC exhibition rules this year, permitting the inclusion of overseas exhibitors whose products contain a significant percentage of British equipment, will ensure that Farnborough 1966 is the biggest SBAC exhibition to date. Unfortunately, despite the increased size and scope, Farnborough does not offer the facilities for adequate demonstration of the performance of hovercraft and associated types of air-cushion vehicles. This situation is doubly unfortunate as the hovercraft concept is basically a British development, and the companies that first embarked on the production of experimental vehicles were members of the aviation industry.

Realising this disadvantage, the British hovercraft industry has already held its own hovercraft show this year. In June, the British Hovercraft Association staged "Hovershow 66", at Browndown on the Solent, and this was attended by visitors from all over the world. In some respects, "Hovershow 66" can be likened to the aviation meetings that were held in the years prior to the First World War. These meetings served to introduce the aeroplane to the public and also to aid the infant aircraft industry. Similarly, "Hovershow 66" illustrated the fact that in less than ten years a new industry had come into being and that a new vehicle was firmly established in the pattern of transportation.

The outstanding feature of the hovercraft concept is the short time that has elapsed between the first demonstration of the idea and the introduction of scheduled passenger services. In 1956, Christopher Cockerell demonstrated his original model hovercraft, and in 1959 the world's first hovercraft, the SR.N1, "flew" for the first time. While the SR.N1 was being built in 1958, Cockerell filed a patent specification covering the addition of flexible extensions or skirts around the periphery of the vehicle to retain the air cushion. This idea is probably the basis for the rapid development of the hovercraft in the past seven years.

In 1959, obstacle clearance was measured in inches, and a craft weighing 4 tons could do about 25 knots at a hover height of some 13 inches. With a jet engine and an all-up-weight of some 7 tons a speed of 50 knots was obtained, but hover height was reduced to 4 inches and there was virtually no overwave performance. With the addition of 18 in. skirts the same craft could maintain 50 knots in a 1½ ft. to 2 ft. sea. Further development in skirt design, to reduce the contact drag and lifting power required, has resulted in a 4 ft. to 5 ft. skirt giving up to 4 ft. obstacle clearance and good performance in 5 ft. waves. The 160-ton craft that enter service in 1968 will have 6 ft. to 8 ft. skirts giving a 6 ft. to 8 ft. overwave performance.

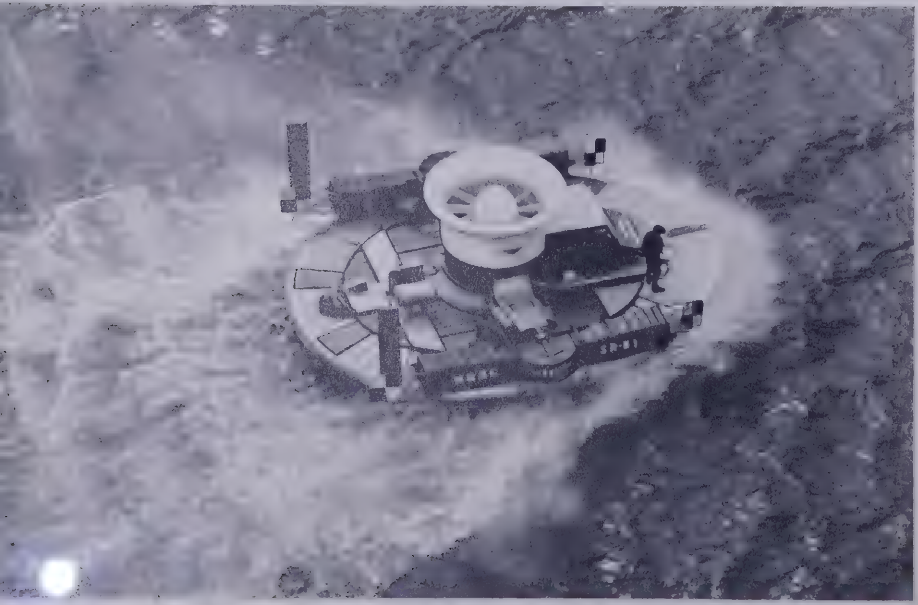
In the past seven years the British hovercraft industry has progressed from experiments, through development, to production. During this period, 42 hovercraft have been built by the industry, and have operated for a total of over 18,000 hours. Commercial services have been established and operated, largely as proving trials of the routes involved rather than of the vehicle, but in 1965 a number of services operated according to published schedules. Already nearly 400,000 passengers have been carried and the passenger/mile figure has reached the 4½ million mark. Hovertravel Ltd., operating a regular cross-Solent service between Ryde, Isle of Wight and Gosport on the mainland, has carried more than 220,000 passengers since July 1965 when the service started. This is the first year-round service to be opened and it has already become a permanent element in the transport pattern of the vicinity; reducing the Solent crossing from 40 to seven minutes.

The next, and one of the most interesting steps in the application of the hovercraft to passenger routes, will be the introduction of cross-Channel services. Two companies have begun pilot services on the route, both having started operations on April 30, 1966. The companies, Hoverlloyd Ltd. and Townsend Ferries Ltd., employ two and one Westland SR.N6 38-seat hovercraft respectively. Hoverlloyd will be using two large Westland SR.N4 hovercraft on this route in 1968; this craft is capable of accommodating 600 passengers, or 30 cars and 228 passengers, or even 800 passengers in commuter conditions. The crossing-time from Ramsgate to Calais would be 22 minutes, and it is estimated that the craft would be able to make 14 round trips in an 18-hour day. In terms of work potential, this means that the SR.N4 can transport the same number of passengers and cars in a day as a 15 knot ship of 3,000 tons.

The emphasis to date has been on the development of commercial hovercraft, but the military possibilities of the vehicle have not been neglected. Applications of hovercraft for military purposes have been mainly concentrated on the logistic support/troop lift role, naval patrolling, and for anti-submarine warfare. Practical experience by the British Defence Services has been based primarily on two units, the Interservices Hovercraft Trials Unit and the Hovercraft Unit (Far East). The experiences of these two units necessarily differ fundamentally from those of any civil operator. The latter are concerned with continuous operations under the most ideal and economic conditions obtainable; the Services on the other hand have had to operate under adverse conditions with regard to climate, terrain and water and also as far as the actual operation of the craft is concerned.

The Interservices Hovercraft Trials Unit was formed in 1961, and is based at Lee-on-Solent. It is jointly manned by the three Services—Army, Navy and Air Force—and has the task of carrying out evaluation of and trials with all hovercraft considered likely to be suitable for use within the Services. It is at present equipped with one SR.N3 which can carry 100 men, or 4 Land Rovers or 4 tons, and three SR.N5s each of which can carry an anti-tank gun or 2 tons or 18 men.

Within the past two years the trials that have been carried out have included anti-submarine warfare, desert operations, R.A.F. crash rescue, troop transporting, and cold weather trials on the Mackenzie River in Canada.



The Mark 1 version of the SR.N1 hovercraft during trials. The SR.N1 is seen here in its original configuration before flexible skirts were fitted, and the photograph illustrates the low hover height and disturbed wake of the vehicle before this vital modification was added.

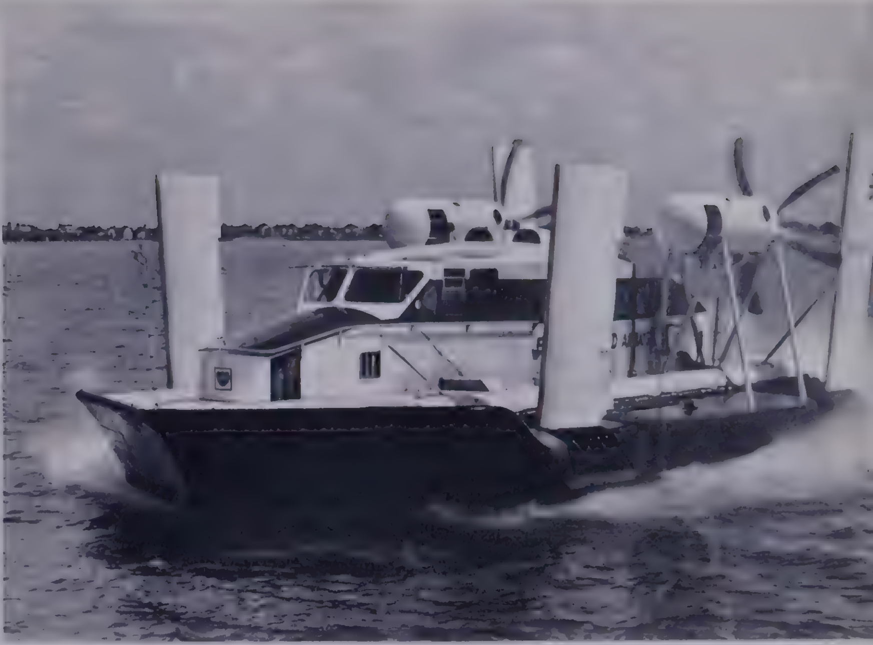
A special hovercraft unit was formed in 1964 in South East Asia, and after carrying out 12 months of trials and operational service has recently returned to the UK. This unit was also jointly manned, and was equipped with two SR.N5s. It was primarily concerned with operating in support of the Army in a logistic and troop lift role in the Borneo territories and proved itself as a highly satisfactory unit complementary to helicopters. It operated over fast rapids where no craft had previously operated, in swamp, marsh and on log-strewn rivers. In the naval role, it operated in the narrow straits around Singapore where it was found to be well suited for fast patrol work in support of coastal or radar patrolling ships. The unit concluded its stay in the Far East by carrying out paddy field trials in Thailand, which proved the efficiency of hovercraft in these conditions.

The craft were standard civilian ones, modified slightly to allow adequate radar and communication facilities, a mounting for a machine gun and the provision of light armour around the engine. They were in no way ideally designed to meet the Service requirements but nevertheless provided valuable experience.

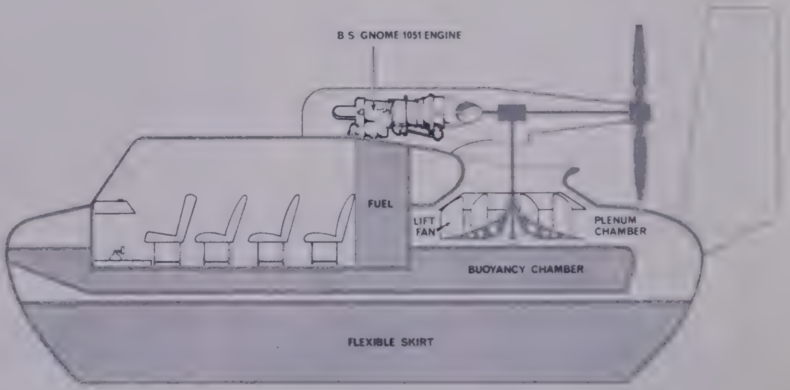
Early next year an operational squadron of the Royal Corps of Transport will be formed. The squadron will be equipped with four modified Westland SR.N6 hovercraft and will be the first operational hovercraft unit, as distinct from trials unit, to go into service. The Interservices Hovercraft Trials Unit will continue to carry out trials on a joint basis and be responsible for ensuring that techniques, maintenance, etc. are pooled on joint experience.

The Royal Navy looks to the future in the possibility of craft designed for fast patrol work, anti-submarine and minesweeping tasks. The Army envisages the use of a general purpose craft, which can be used for logistic, patrol and ship to shore operations. The R.A.F., for whom the role of the hovercraft is more limited, nevertheless sees these craft as ideally suited for search and rescue work and for fire fighting purposes, particularly around airfields sited either in an environment similar to that of the Mekong Delta or near the coast where marsh and saltings would hamper search and rescue operations.

*

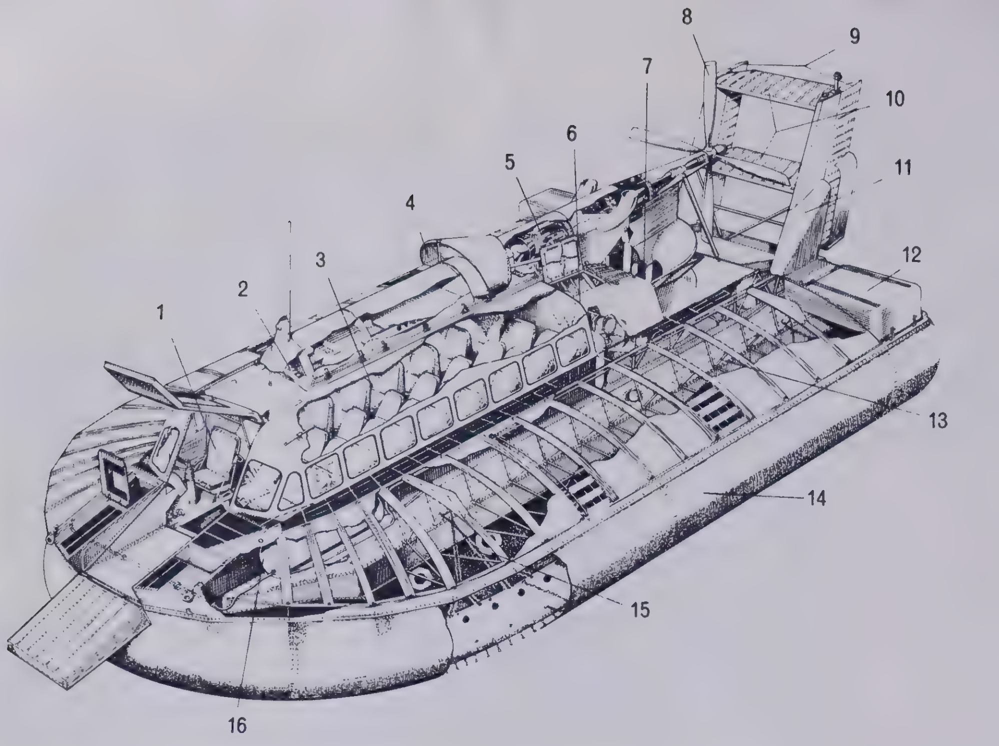


This Vickers VA-3 operated by British United Airways and Vickers-Armstrongs (Engineers) Ltd. inaugurated the world's first commercial hovercraft service on July 20, 1962. The route chosen was across the shallow estuary of the River Dee, between the towns of Wallasey and Rhyl. Four Bristol Siddeley *Turmo 603* turboshaft engines power the VA-3, giving a speed of 60 knots. In the experimental service the craft seated 24 passengers.

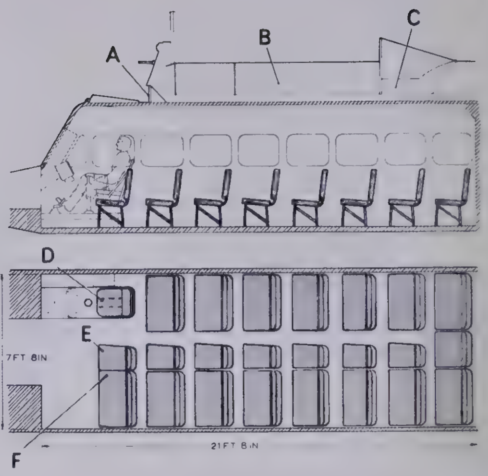


The second production model of the Westland SR.N5 during proving trials. Since production of this small hovercraft began, orders have been received from Norway, United States, Germany, Japan and Brunei. The cutaway drawing illustrates the layout of the combined propeller/lift fan drive and the position of the 15 in. deep buoyancy chamber beneath the cabin structure.

The Westland SR.N6 is 10 ft. longer than the SR.N5 and incorporates many of the systems and components developed on the smaller craft. The SR.N6 is powered by a single Bristol Siddeley *Marine Gnome* engine, giving a maximum speed of 59 knots.



Constructional details of the Westland SR.N6. Key: 1 – driver's station; 2 – cabin air intake; 3 – 38-seat cabin; 4 – engine air intake; 5 – Bristol Siddeley *Marine Gnome* engine; 6 – main fuel tank; 7 – lift fan; 8 – Dowty Rotol reversible pitch propeller; 9 – rudders; 10 – tail planes; 11 – air bleed ducts; 12 – equipment panniers; 13 – buoyancy tanks; 14 – flexible skirts; 15 – skirt lifting controls; 16 – fuel/ballast tank.



Internal layout of the SR.N6. Key: A – cabin air intake; B – dinghy stowage; C – provision for air conditioning; D – driver's station; E – folding seats (7); F – fixed seats (31).

This brief summary of the development of the hovercraft concept in Britain illustrates the speed at which the principle has been translated from an idea to a working transport vehicle. What of the industry itself? Its establishment can be said to date from the award of a study contract to Saunders-Roe (now a Division of Westland Aircraft Ltd.) by the Ministry of Supply. From this contract evolved the SR.N1 which effectively demonstrated the merits of the basic concept.

The structure of the British hovercraft industry was initially based on a subsidiary of the National Research Development Corporation: Hovercraft Development Ltd. This subsidiary was set up to control the patents covering Cockerell's inventions and has licensed several companies to manufacture vehicles under the registered trademark of Hovercraft. Time and experience revealed that this structure resulted in a certain duplication of effort. To eliminate this the British Hovercraft Corporation was formed to amalgamate the major technical and other resources under a central direction. The new corporation will deal with all possible applications of the air-cushion principle. So far, emphasis has been on overwater craft, but future activity will also include such applications as hovertrains and heavy load, overland vehicles. The capital of the British Hovercraft Corporation is £5 million, 65 per cent of it held by Westland Aircraft Ltd., 25 per cent by Vickers Ltd. and 10 per cent by the National Research Development Corporation.

Outside the British Hovercraft Corporation, the only other company in Britain at present engaged in hovercraft construction under HDL licence, is Britten-Norman Ltd. The Hovercraft Division of Britten-Norman is being separated from the parent company and when this is completed BHC will purchase a 20 per cent share.

Other companies engaged in air-cushion vehicle development (as distinct from hovercraft as they are not HDL licensees) include Hovermarine Ltd. and Manx Hovercat Ltd. Hovermarine specialises in the rigid sidewall concept of air cushion vehicle development and was recently awarded a Ministry of Aviation feasibility study contract. The rigid sidewall non-amphibious craft are particularly suitable for applications such as river ferries where their speed of 25–35 knots gives them a distinct advantage over conventional river craft, and their directional control allows them to operate on busy and winding waterways. Hovermarine has also proposed a rigid sidewall helicopter carrier for sea-air operations. A small carrier of this type for operation in inshore and sheltered waters could be produced with a gross weight of about 50 tons. This size would offer adequate beam width for a helicopter platform and the craft would have an operational range of over 1,000 miles.

Manx Hovercat Ltd. are producing a 4–5 seat "family size" hovercraft which will be both cheap and simple to run and will cost less than £5,000. The *Hovercat* is constructed in glass fibre and is powered by two Volkswagen 1600 engines. The craft is of plenum chamber design and the proposed applications include river and harbour police work, and as a communications vehicle in underdeveloped countries where the changing terrain requires a rapid, amphibious craft.

Apart from research carried out by individual companies, two organizations provide research support to the industry. The Technical Group of Hovercraft Development Ltd. undertakes a wide range of investigation work and the results are made available in the form of technical reports to the two HDL licensees: British Hovercraft Corporation and Britten-Norman Ltd. Significant new ideas are the subject of fresh patents and these too are made available to the licensees. Close collaboration is maintained with other technical establishments such as the National Physical Laboratory.

The Royal Aircraft Establishment began research into ground effect machines in 1962 when the Britten-Norman CC-2 *Cushioncraft* was bought and a programme of research into the performance, control and stability of hovercraft was started. The aim of the R.A.E. work is to obtain data which is applicable to all hovercraft. To ensure this, the CC-2 programme has been

In 1965, Clyde Hover Ferries Ltd. introduced passenger ferry services on the River Clyde in Scotland, using an SR.N6. This photograph emphasises the simplicity of the berthing arrangements for hovercraft, in contrast to the pier facilities for displacement vessels in the background.

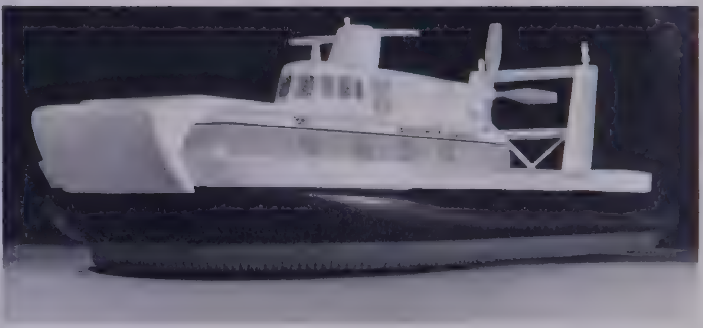
supplemented by close collaboration with the Interservices Hovercraft Trials Unit. Tests have been undertaken on the SR.N2 and SR.N3 and an extensive research programme is to start on the SR.N5 in the near future.

Within the space of ten years, an idea has been converted into reality, a new industry has been established, a new method of transport has been introduced, and operating companies have commenced scheduled passenger carrying services. These are outstanding achievements and they confirm the fact that this new type of transport distinctly meets a variety of needs, and meets them very efficiently. Now, what of the future?

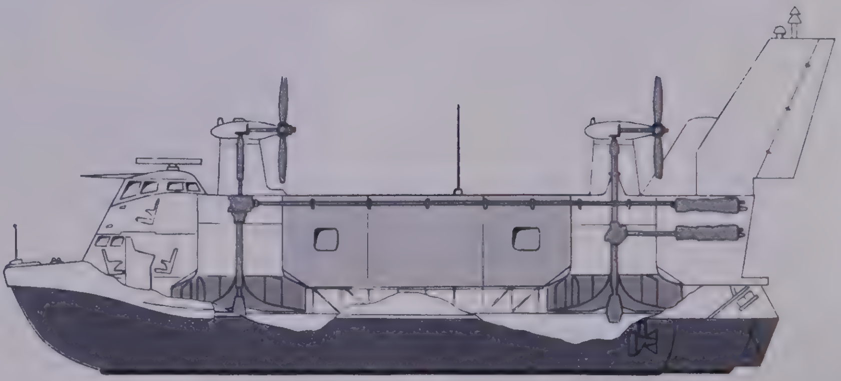
It would appear that the essence of the answer can be summed up in one word – finance. Admittedly this is invariably the key problem in the majority of new enterprises and it is not surprising that it should affect the development of hovercraft. Like many other examples of new technologies, hovercraft are not cheap. In terms of capital costs a small craft (up to approx. 10 tons gross weight) will cost in the region of £100,000. A medium size craft (about 100 tons) will be around £½ – ¾ million and a large craft (160 tons) about £1½ million. Add to these figures the cost of research and development, plant, staff, factory facilities and similar overheads and it becomes obvious that the small company is barred from entering the industry. Quite obviously this is one of the basic reasons for the formation of the British Hovercraft

A Westland SR.N5 of the Interservices Hovercraft Trials Unit operating over marshland during trials in the rescue role. The depth of the gulleys visible on the right indicates the cross-country capability of the hovercraft and its ability to cross terrain that would be impassable for all other vehicles

A model of the British Hovercraft Corporation's BH.7 project. This 40-ton open-water craft is 70 ft. in length and has a beam of 40 ft. The BH.7 is suitable for a wide range of civil and military applications and is powered by one 3,400 s.h.p. Bristol Siddeley *Marine Proteus* gas turbine giving a maximum continuous calm water speed of 75 knots.



At the moment, the 37-ton Westland SR.N3 is the largest hovercraft in the world. For the past two years the Interservices Trials Unit has been evaluating this craft in a number of military roles, both over-water and amphibious, including anti-submarine warfare, amphibious assault, logistic support and rescue.



This sectional drawing of the SR.N3 shows the amount of payload space (light grey) and details of the engine and transmission system (dark grey). The four *Gnome* engines are mounted in pairs at the stern of the vessel and the two Rover gas turbines are fitted at the top of the outboard propeller shaft struts. These marine engines also function as auxiliary power units.

The Westland SR.N3 of the Interservices Hovercraft Trials Unit ashore at an Army training area in Southern England. The SR.N3 is powered by four 1,050 s.h.p. Bristol Siddeley *Marine Gnome* gas turbines giving a cruise speed of 70 knots.

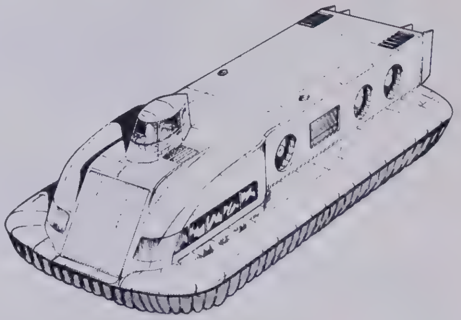
Corporation and concentration of the British hovercraft industry's major resources under one management.

The announcement of the formation of the BHC provoked some comments to the effect that size is not synonymous with efficiency, and that this concentration would stifle the appearance of new ideas. It is hard to see how these criticisms can be justified. In the few years since the beginnings of the industry some £10 million from industrial and Government sources has been invested in hovercraft development. This amount is already twice the capital of the newly formed BHC so it can be assumed that the management of Westland Aircraft (the major manufacturer of hovercraft) has faced some difficult problems during the past years in deciding the amount of effort to be devoted to hovercraft at the expense of the established helicopter activity. Such division of effort always offers the possibility of failure on both fronts; the formation of BHC should have eliminated this possibility.

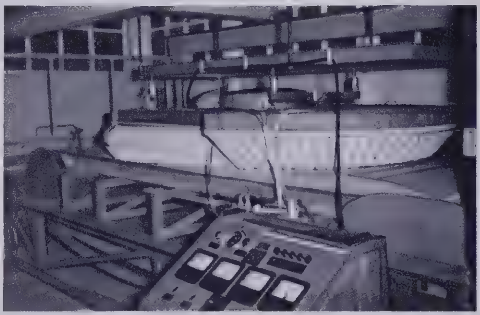
The Corporation's immediate development programme, covering the next five years, includes two new craft — the BH.7 and BH.8 — civil versions of which will fill the gap at present existing between the 9-ton, 38-passenger SR.N6 and the 160-ton SR.N4. The BH.7 will be powered by a Bristol Siddeley *Marine Proteus* and will have a nominal gross weight of 40 tons. It will be capable of over 40 knots in significant wave heights of 6 ft. and will carry 145–165 passengers according to seating layout. As a passenger/car ferry it will carry eight cars and 60–70 passengers.

The BH.8 will have a nominal gross weight of 80 tons and be capable of overloading to 100 tons. A top speed of 80 knots is envisaged, and the craft will be suitable for rough sea operation in open waters. Typical passenger capacity will be 280, mixed load capacity 14 cars and 110 passengers, and freight capacity 35 tons.

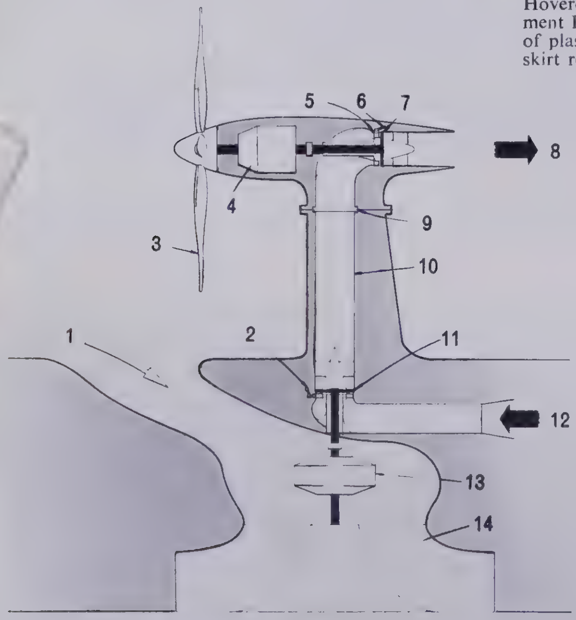
Right: The Britten-Norman *Cushioncraft* CC-5 is a six to eight passenger amphibious vehicle powered by a Rolls-Royce V-8 engine. The CC-5 is extremely quiet and is propelled and steered entirely by low pressure air jets.



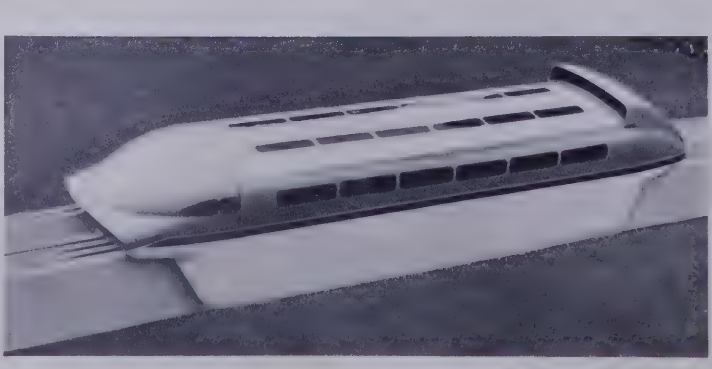
Above: An artist's impression of the Britten-Norman CC-6 car ferry. The vehicle will have a capacity for 4—5 cars and 30—40 passengers. One of these vehicles has been ordered by Hovertravel Ltd.



Hovercraft research facilities at Hovercraft Development Ltd. A fixed model suspended over an endless belt of plastic "waves" is used to investigate ride motion and skirt response characteristics.



A Rolls-Royce proposal employing *Avon* engines and free power turbines in series for hovercraft lift and propulsion. Key: 1 – air inlet to lift fan; 2 – variable nozzle operating ring; 3 – tractor propeller; 4 – propeller reduction gear; 5 – variable nozzle; 6 – nozzle operating ring; 7 - free power turbine (propulsion); 8 – exhaust; 9 – pylon swivel gas joint; 10 – pylon gas duct; 11 – free power turbine (lift); 12 – gas from *Avon* engines; 13 – fan reduction gear; 14 – lift fan.



A working model built at Hovercraft Development Ltd. of a tracked *Hovercar*. The model is 6 ft. in length and embodies the basic features of the concept, including a representative configuration of air cushion lift, and guidance pads employing thin, peripheral air curtains. A second stage of suspension is fitted between the lift and guidance pads and the vehicle body. A linear induction motor is employed for traction.

The BHC development programme has as ultimate target the production of a 400-ton Hovership, with open water capability, fairly long range and considerable load carrying capacity. Already, it is possible to extrapolate present technology to project a Hoverfreighter of 4,000 tons, with an open sea range of 1,000 nautical miles, a speed of 40–50 knots, and a freight passenger capacity equal to 1,600 tons.

It is impossible to forecast the future progress of the industry but a brief situation report gives grounds for optimism. In the space of ten years a new concept has been introduced and proved; the world's first hovercraft production line laid down; craft have been built and are operating commercially, and orders are in hand for new craft. The majority of these being for overseas customers.

To prevent over-optimism, certain other factors should be taken into account. World-wide competition is increasing rapidly and already types of air-cushion vehicles are being built in the USA, France, Russia, Japan, Sweden and Israel. In the USA, preparations are underway for an ambitious hovercraft development programme and experimental commercial operations have already started. It is confidently expected that the US Government will introduce a number of high cost programmes in the future which will provide the necessary impetus for the industry. If this is the case the scale of competition for the British industry will rapidly increase.

In France, the Société Bertin has been engaged in air-cushion vehicle research for many years, and in conjunction with Nord-Aviation in the SEDAM Company, now has a range of projects for craft up to 500 tons. An 80-seat vehicle is due to start trials next year. The most important feature of the Bertin programme is the work that has been done on the *Aerotrain*. This is the first application of the air-cushion principle to tracked vehicles and the company has already built a full-size vehicle and a 4-mile length of trackway. Speeds of over 120 m.p.h. have already been attained in trials.

Tracked hovercraft development is at present the weakest sector of the British hovercraft effort. Work has been in progress at Hovercraft Development Ltd since 1960 and a special air-cushion suspension system has been developed. Unfortunately the transport authorities in Britain have not offered the same scale of support that the French railway authorities have given Société Bertin. Consequently, HDL is limited to demonstrating the concept with a 6 ft. working model employing a linear induction motor for traction. This motive power system is entirely new and is one of the most interesting features of the HDL design.

In a remarkably short space of time the British hovercraft industry has attained an advanced stage of development. It has amassed a considerable background of technical knowledge and practical experience and should face a period of expansion. Quite obviously, overseas competition will increase, but "Hovershow 66" at least demonstrated that the industry has a broadly based programme for the future. ✦✦

SR.N5

The SR.N5 design is based on a 15-inch deep buoyancy tank, sub-divided into watertight compartments. The cabin, positioned forward, is set into the plenum chamber and buoyancy tank. Easy access to the cabin is by a bow-loading door. The vehicle is capable of carrying 18 passengers or 2 tons of freight. Power for propulsion and the air cushion lift is provided by a Bristol Siddeley *Marine Gnome* engine situated to the rear of the cabin. By a simple mechanical system, the engine is coupled to a single lifting fan and a variable pitch propeller. Control of the craft is by rudders and elevators mounted on the twin fin/tailplane unit, which operates in the propeller slipstream. A skirt system is also provided to give extra control, particularly at low speeds. The 4-foot skirts give the SR.N5 an outstanding rough-country and over-wave performance. Its amphibious capabilities enable the craft to operate over ice, sand and mud flats, and debris strewn waters. It is a particularly suitable vehicle for military duties, as its power to weight ratio gives it exceptional operational adaptability.

Power plant and systems

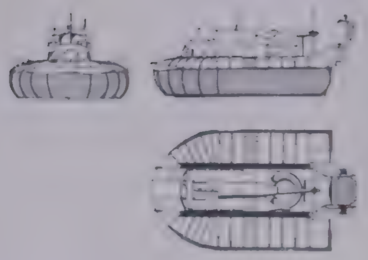
Engine: One Bristol Siddeley *Marine Gnome* gas turbine developing 900 s.h.p. at max. continuous power.
Propeller: Dowty Rotol 4-blade variable pitch, 9 ft. diameter.
Lift fan: Westland centrifugal, 7 ft. diameter.
Fuel: Standard kerosene.
Fuel capacity: 265 Imp. gal.

Performance (at 15°C)

Maximum speed over calm water (max. power)	66 knots
Maximum speed over calm water (max. cont. power)	62 knots
Calm water range	205 n.m.
Endurance at max. cont. power	3.6 hours
Max. gradient in static conditions	1 in 6

Dimensions

Length overall	38 ft. 9 in.
Beam overall	23 ft.
Height overall	12 ft. 11 in.
Basic weight	4.06 tons
Normal gross weight	6.57 tons



SR.N6

Many of the fully-developed systems and components used in the SR.N5 have been incorporated in the design of the SR.N6. This extensive use of proven components coupled with increased payload capability (achieved without an increase in installed power), has resulted in improved operating economics. The SR.N6 is designed primarily as a passenger transport and can accommodate 38 passengers. If required, the cabin can be rapidly converted to carry 3 tons of freight.

Being completely amphibious, the SR.N6 can operate from relatively unsophisticated bases situated above the high-water mark, irrespective of the state of the tide and the depth of the water. Directional control is achieved by two rudders and all-moving tailplanes incorporated in the twin fixed fin assembly, plus an auxiliary air porting system. Manoeuvrability is further improved by a skirt lifting system.

Power plant and systems

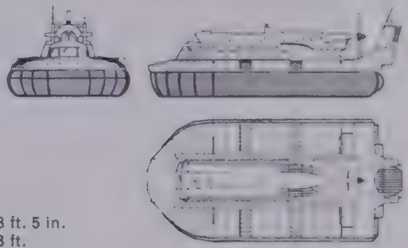
Engine: One Bristol Siddeley *Marine Gnome* gas turbine developing 900 s.h.p. at max. continuous power.
Propeller: Dowty Rotol 4-blade variable pitch, 9 ft. diameter.
Lift fan: Westland centrifugal, 7 ft. diameter.
Fuel: Standard kerosene.
Fuel capacity: 265 Imp. gal.

Performance (at 15°C)

Maximum speed over calm water (max. power)	59 knots
Maximum speed over calm water (max. cont. power)	56 knots
Speed in 4–5 ft. waves	36–49 knots
Still air range	200 n. m.

Dimensions

Length overall	48 ft. 5 in.
Beam overall	23 ft.
Height	15 ft.
Cabin size	21 ft. 9 in. × 7 ft. 8 in.
Cabin floor area	166 sq. ft.
Normal gross weight	9.12 tons
Max. gross weight	10.3 tons



SR.N3

The 37½-ton SR.N3 was delivered to the Interservices Hovercraft Trials Unit in 1964. Since that date it has been used in a variety of amphibious and over-water roles to assess possible military applications for hovercraft. The large freight cabin and the high disposable load allows the SR.N3 to accommodate a variety of operational weapons systems or to transport substantial loads of troops or supplies. In addition to its high speed amphibious capabilities, the SR.N3 is also suitable for extended low speed patrolling, using two small power units to drive outboard water screws. The flexible skirts give it good over-wave and obstacle clearance capabilities. The vehicle can surmount a wall 3 ft. 6 in. in height, and ditches up to 20 ft. wide can be crossed at 40 knots. Its performance over ice extends its operational flexibility to include such areas as the Baltic and Arctic.

Power plant and systems

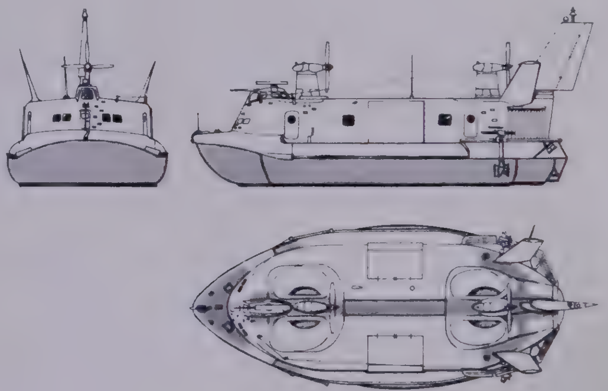
Engines-main: Four 1,050 s.h.p. Bristol Siddeley *Marine Gnome* gas turbines.
Marine: Two 150 s.h.p. Rover 2S/150/SR gas turbines driving two outboard propellers.
Propellers-main: Two Dowty Rotol 4-blade variable pitch, 10 ft. diameter.
Marine: Two Troost.
Lifting fans: Two Westland centrifugal, 12 ft. 6 in. diameter.
Fuel: Standard kerosene.
Fuel capacity: 2,700 Imp. gal., 270 Imp. gal. reserve.

Performance

Maximum speed	70 knots
Endurance	9½ hours
Wave clearance at 50 knots	5 ft.
Max. gradient in static conditions	1 in 10

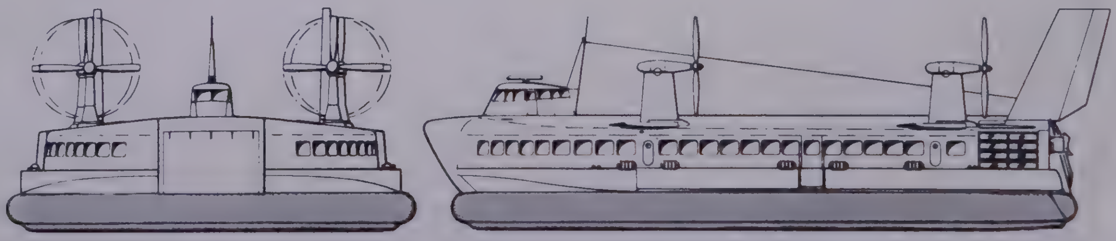
Dimensions

Length overall	77 ft.
Beam overall	30 ft. 6 in.
Height overall	32 ft.
Basic weight	52,000 lb.
Disposable load	31,800 lb.
Max. gross weight	84,000 lb.



SR.N4

The 160-ton SR.N4, now in production, is a fast passenger/car ferry designed for operations on open sea routes. The deck area can be equipped to suit operator requirements. Typical layouts include all-passenger versions carrying 500 people seated or 700/800 commuter passengers on short routes. The passenger/car ferry version will carry 250 people seated and 32 cars. In addition, the SR.N4 can be used to carry freight. The SR.N4 fitted with 6 ft. flexible skirts, etc. will be capable of operating in 10 ft. seas, normally the maximum sea state envisaged for open water routes such as the English Channel. In calm weather it can carry a disposable load of 66 tons at a maximum cruising speed of 70 knots over distances of up to 290 nautical miles.



Power plant and systems

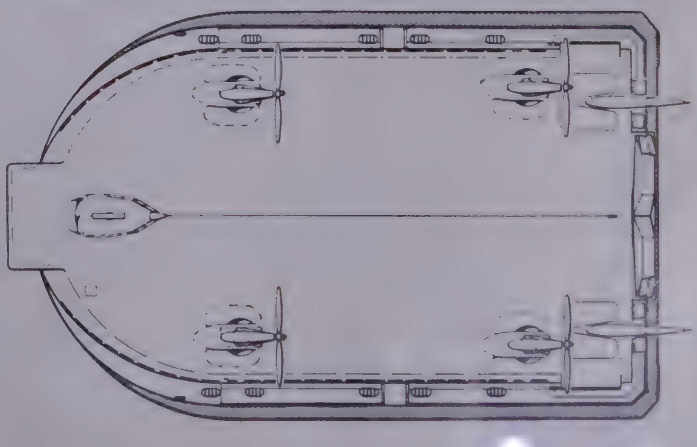
Engines: Four 3,400 s.h.p. Bristol Siddeley *Marine Proteus* gas turbines.
Propellers: Four 4-blade variable pitch, 19 ft. diameter.
Lift fans: Four Westland centrifugal fans, 11 ft. 6 in. diameter.
Fuel capacity: 4,500 Imp. gal.

Performance (at 15°C)

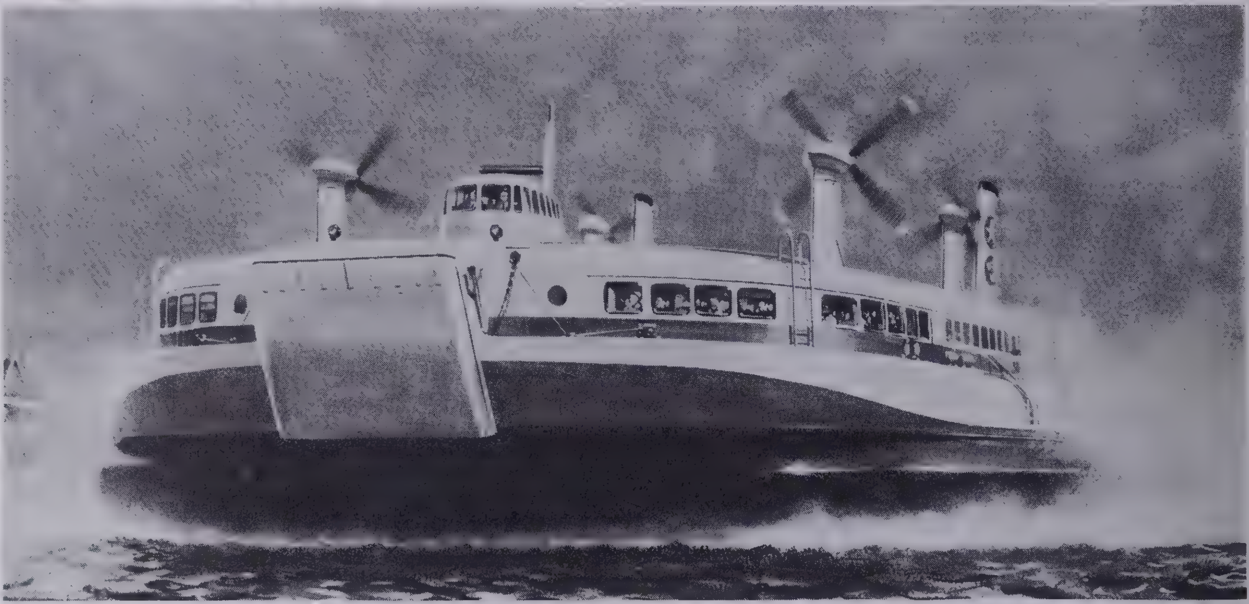
Max. still air speed over calm water (max. power)	77 knots
Max. speed over calm water (max. cont. power)	70 knots
Speed in 4–5 ft. waves	55–65 knots
Speed in 8–10 ft. waves	20–30 knots
Still air range	290 n. miles

Dimensions

Length overall	128 ft. 6 in.
Beam overall	75 ft.
Height overall	36 ft. 8 in.
Passenger/vehicle floor area	5,800 sq. ft.
Disposable load	66 tons
Normal gross weight	160 tons
Max. gross weight	180 tons



STRENGTH THROUGH UNITY



Artist's impression of the 160-ton SR.N4 with which Hoverlloyd is to open a passenger/vehicle ferry service across the English Channel in 1968.

British Hovercraft Corporation controls all the British hovercraft industry's major resources. Wasteful duplication of effort is thus avoided and the maximum competitive ability maintained.

The BHC plant at Cowes, Isle of Wight, houses the world's only hovercraft production line. A 'run' of 40 SR.N5's and SR.N6's is in hand, and the first four 160-ton SR.N4 passenger/vehicle ferries are also under construction.

BHC hovercraft have already amassed over 20,000 hours of operation—many times the total for any other manufacturer.

The target of the Corporation's immediate development programme is a 400-ton hovership in four to five years' time. Non-marine applications of the air-cushion principle are also under investigation, among them, hovertrains, heavy-load transporters, and hoverpallets for industrial use.

BHC

YEOVIL ENGLAND **british hovercraft corporation limited**

1966
THE QUEEN'S AWARD
TO INDUSTRY 1966
WESTLAND AIRCRAFT LIMITED
SAUNDERS-ROE DIVISION

FABAG DRUCK ZÜRICH

28 leaflets

british hovercraft

INFORMATION

POLAR
PAM
4646

POLARPAM

BHC
british hovercraft corporation limited
YEOVIL ENGLAND

THE BOREAL INSTITUTE
LIBRARY

1966
WESTLAND AIRCRAFT LTD
SAUNDERS ROE DIVISION